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Continuation of Serial No. 09/915,858
Filed July 26, 2001
Title: ELECTRONIC TIRE MANAGEMENT SYSTEM
Examiner Daryl C. Pope; Art Unit 2632
Ronald A. Sandler; 312-269-4352

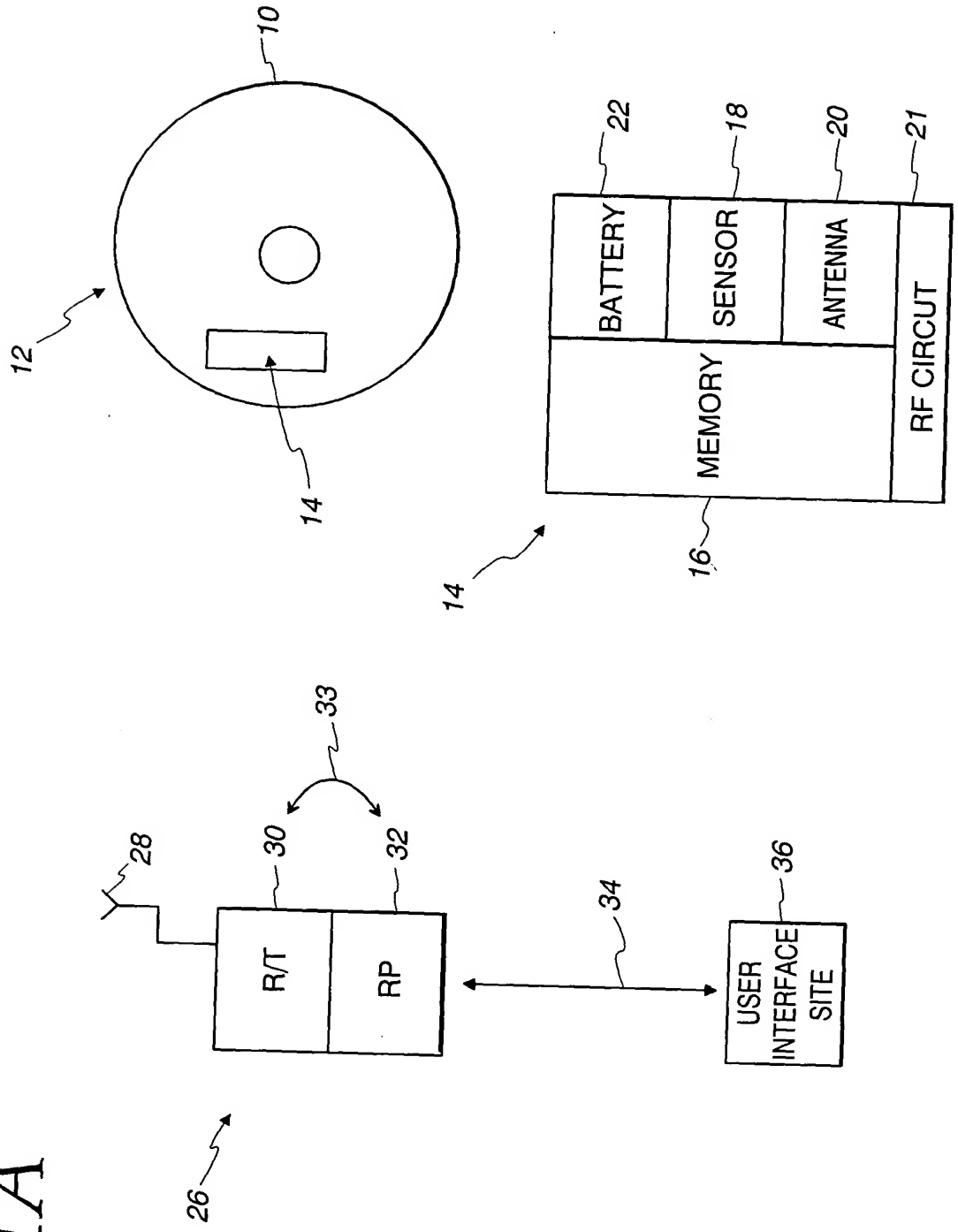

Fig. 1A

Fig 1B

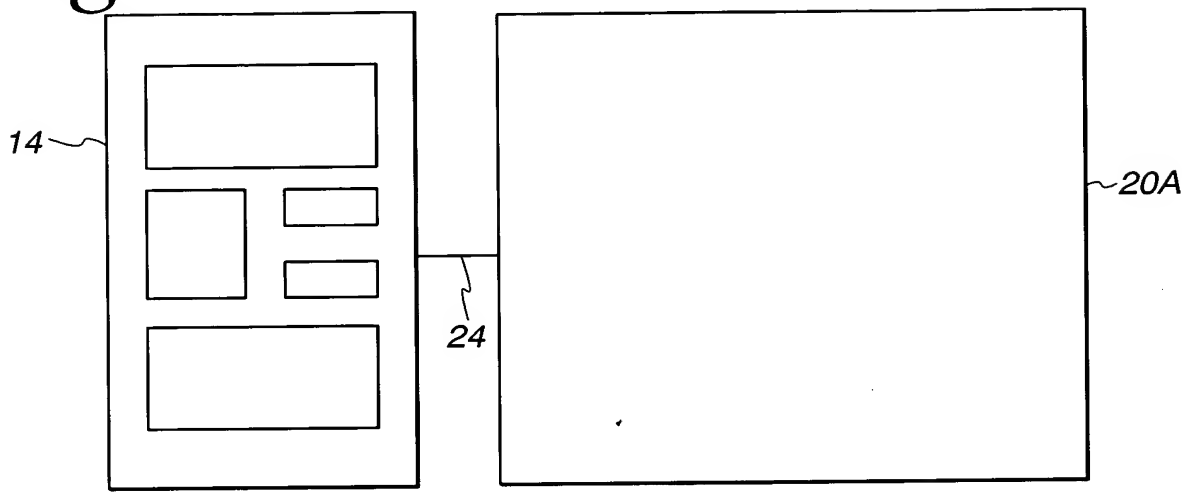

Fig 1C

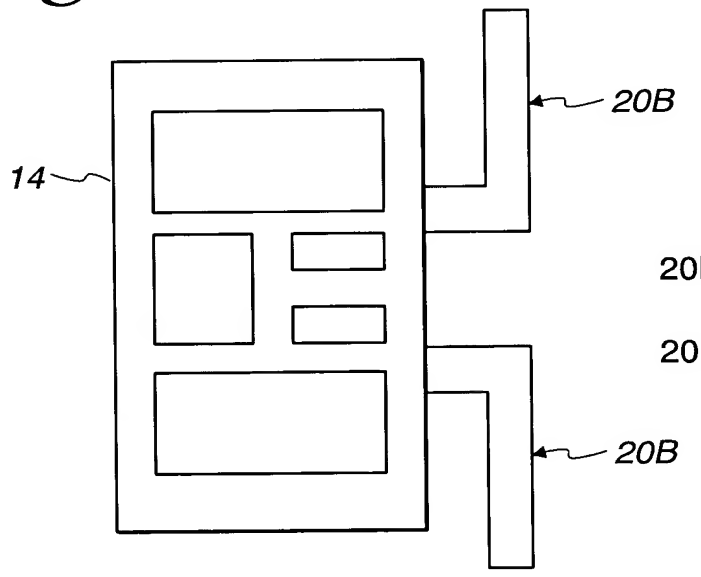

Fig 1D

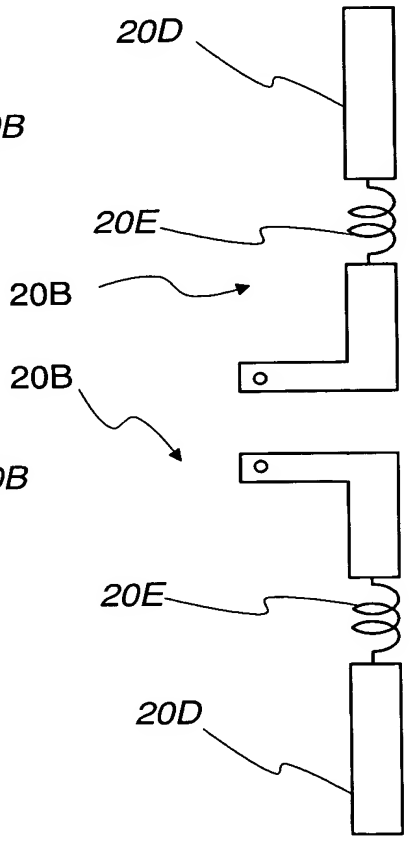

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Fig. 2C

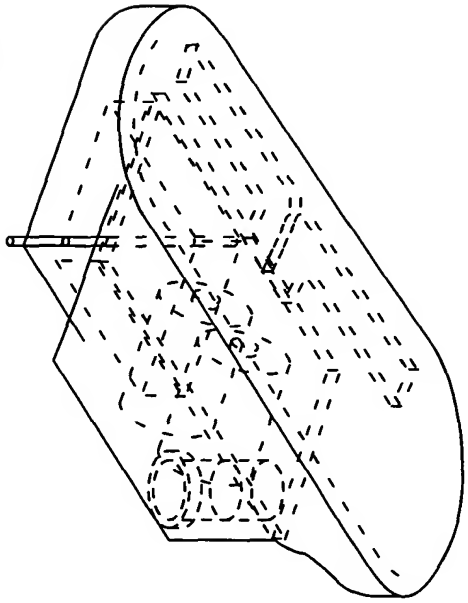


Fig. 2D

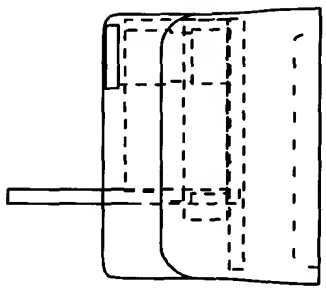


Fig. 2A

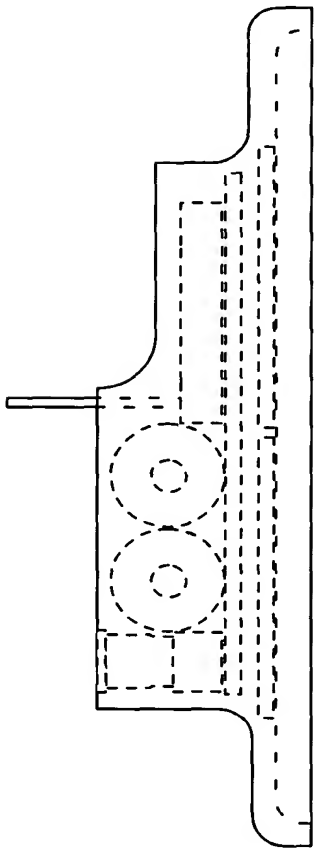


Fig. 2B

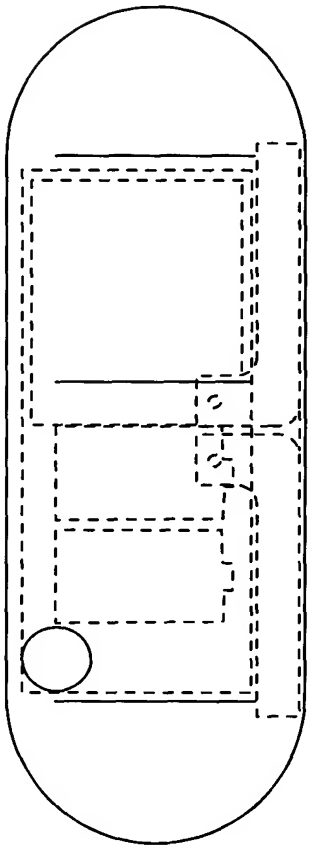


Fig. 3C

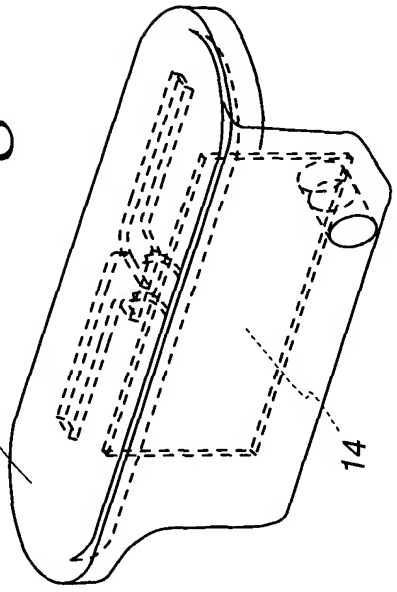


Fig. 3D

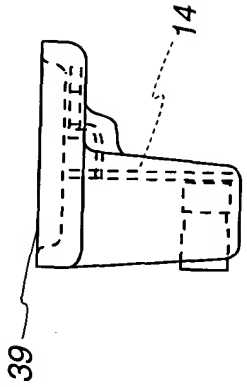


Fig. 3B

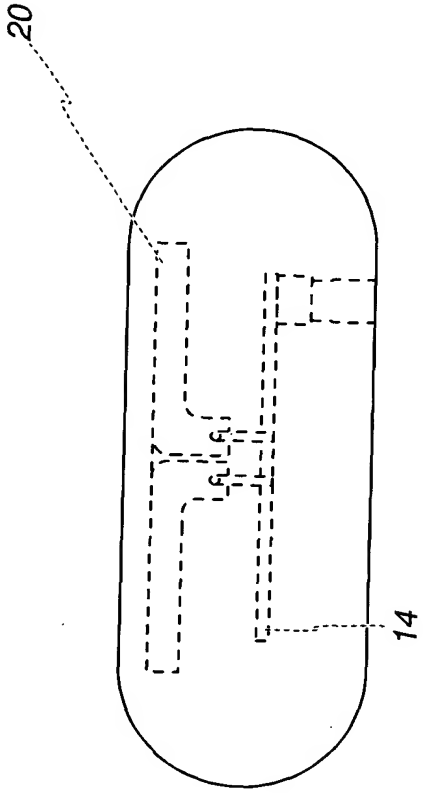
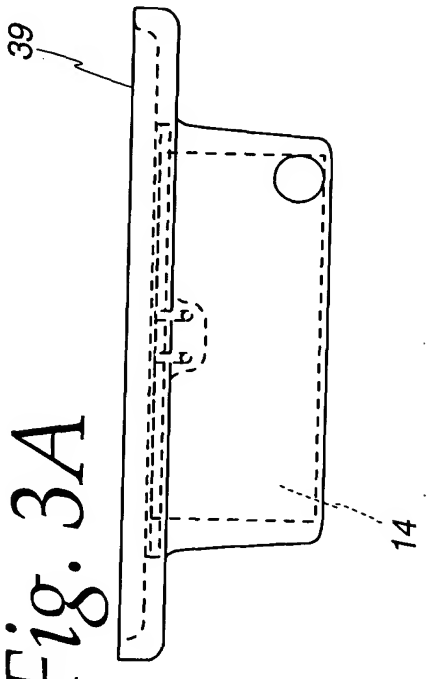


Fig. 3A



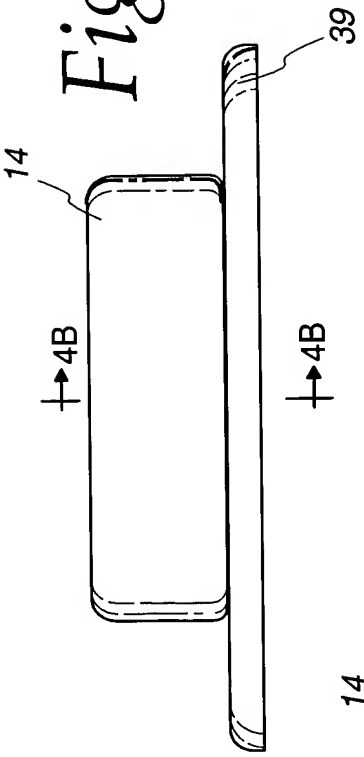


Fig. 4A

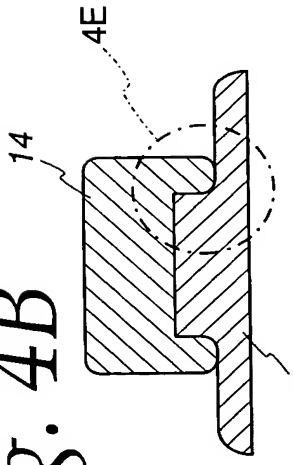


Fig. 4B

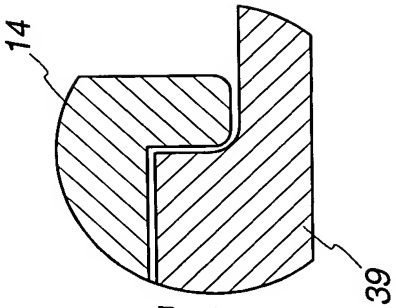


Fig. 4E

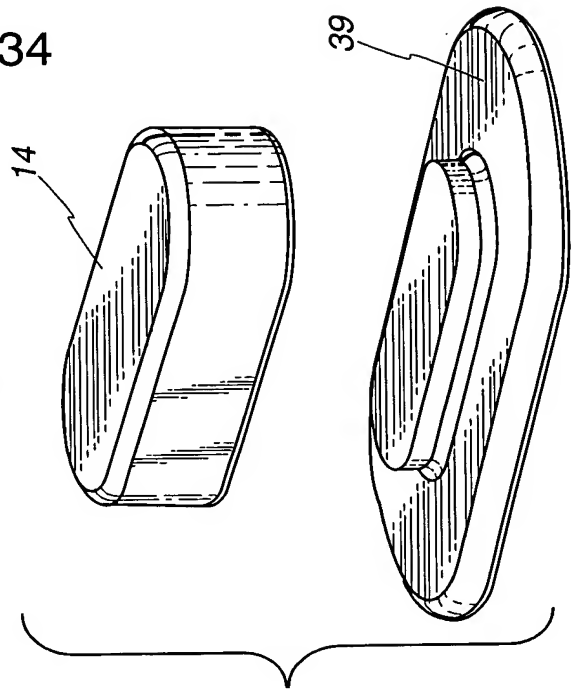


Fig. 4C

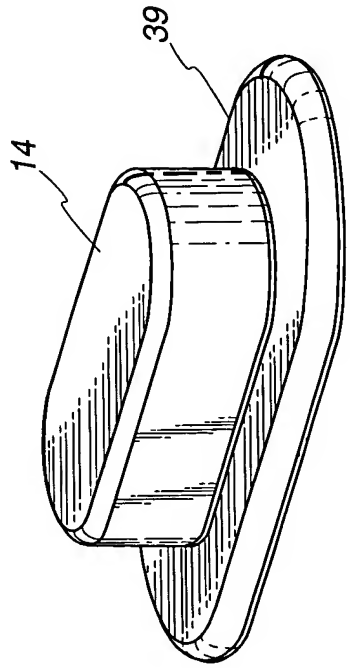


Fig. 4D

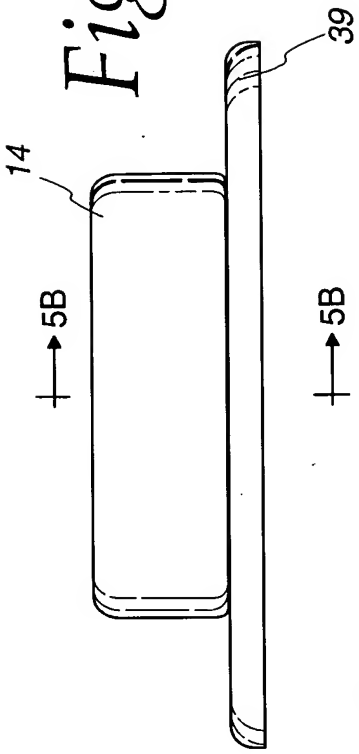


Fig. 5A

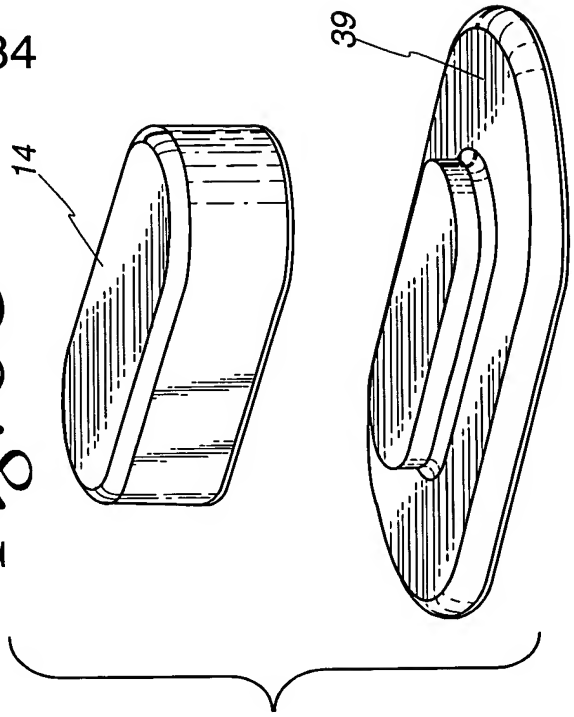


Fig. 5C

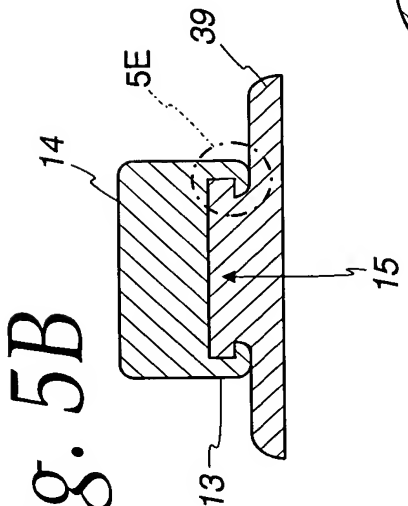


Fig. 5B

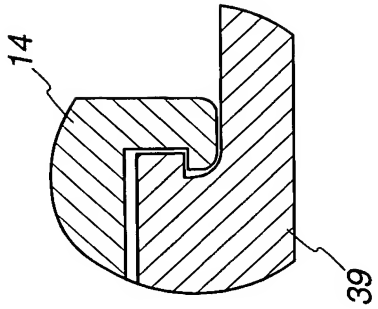


Fig. 5E

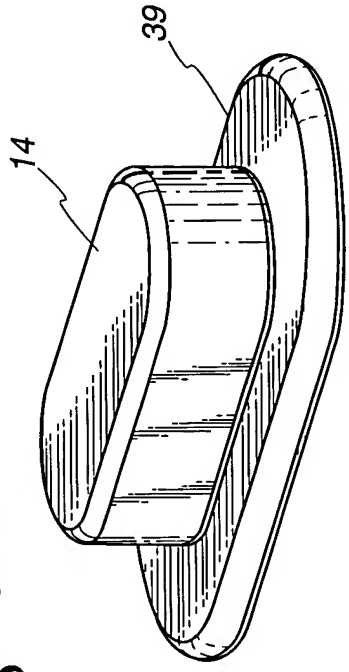


Fig. 5D

Fig. 6C

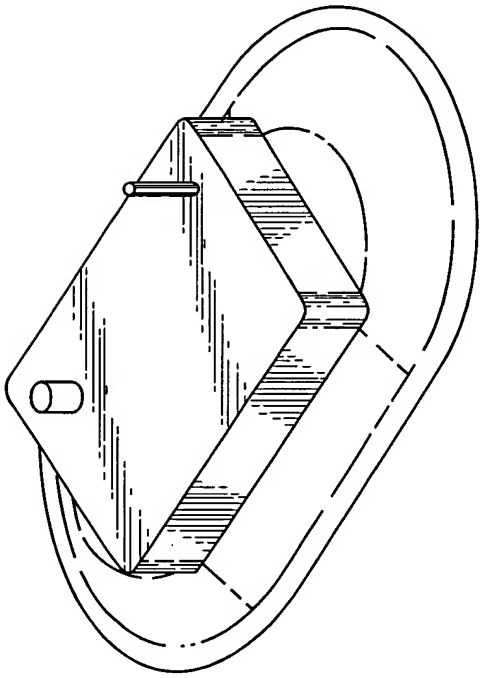


Fig. 6D

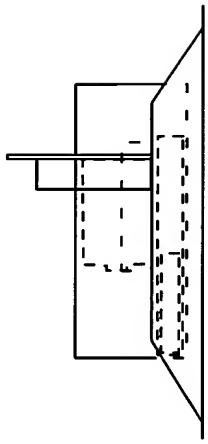


Fig. 6A

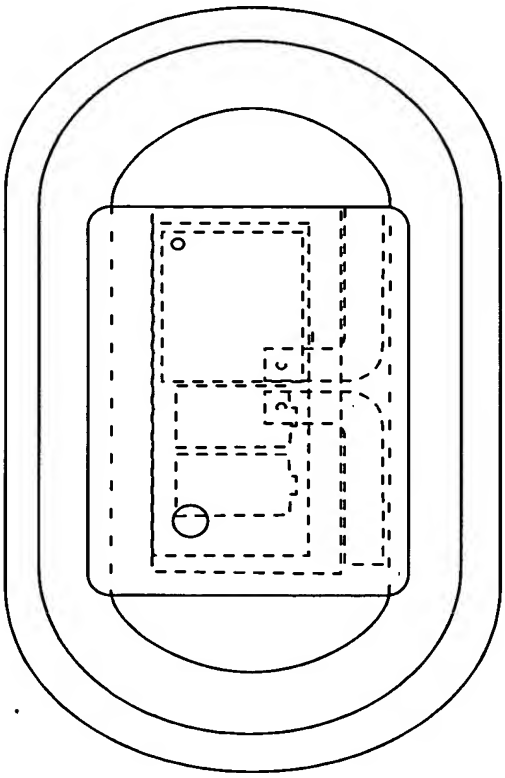


Fig. 6B

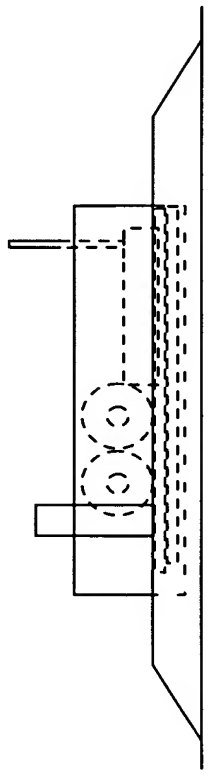


Fig. 7D

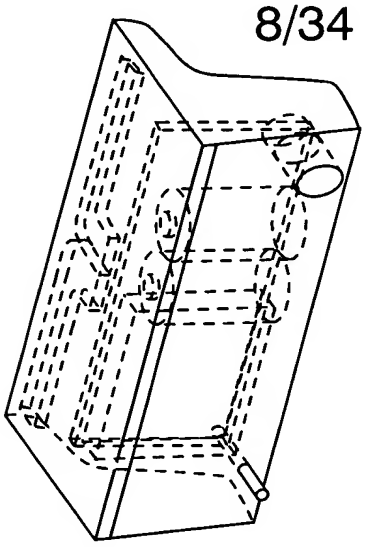


Fig. 7C

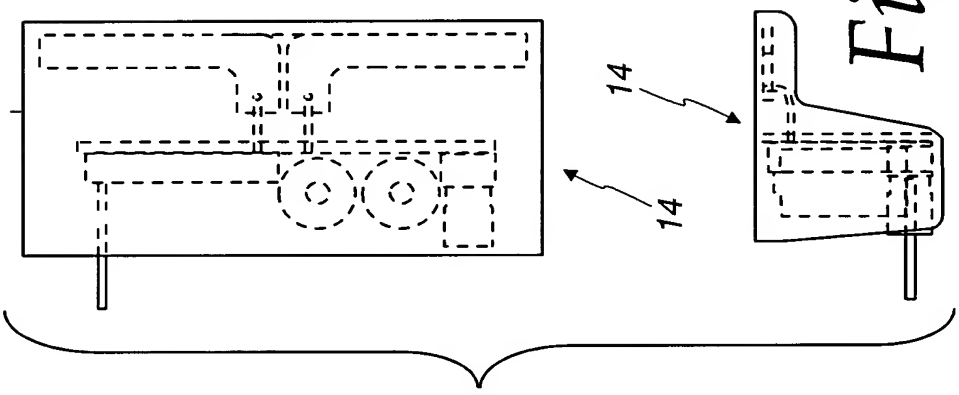


Fig. 7A

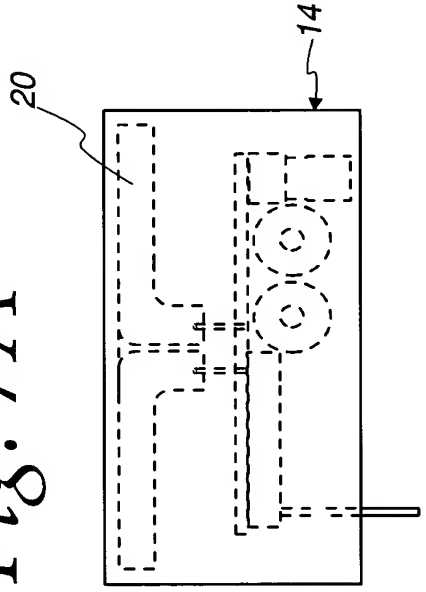
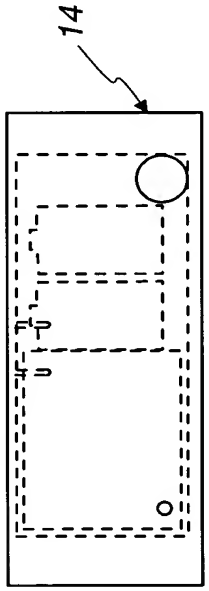


Fig. 7B



TAG NORMAL TO ANTENNA WITH REV C BOARD

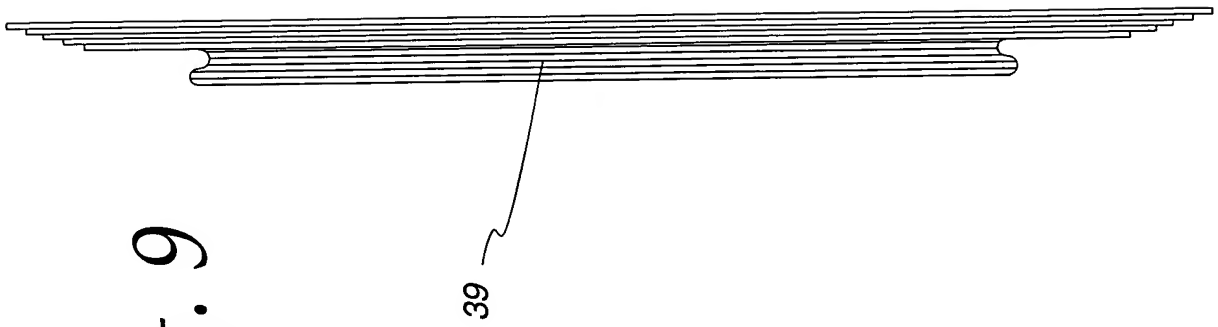


Fig. 9

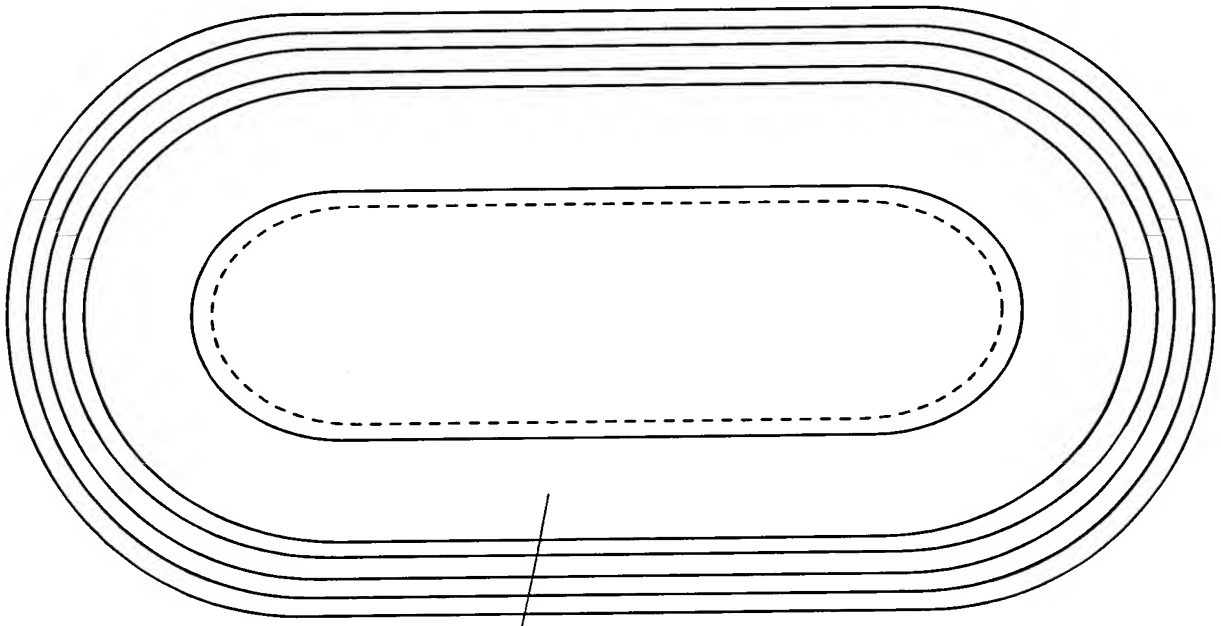


Fig. 8

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Ronald A. Sandler; 312-269-4352

Fig. 10C

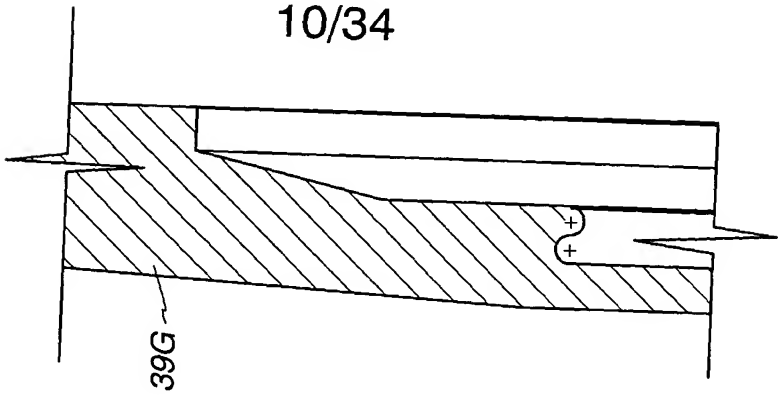


Fig. 10A

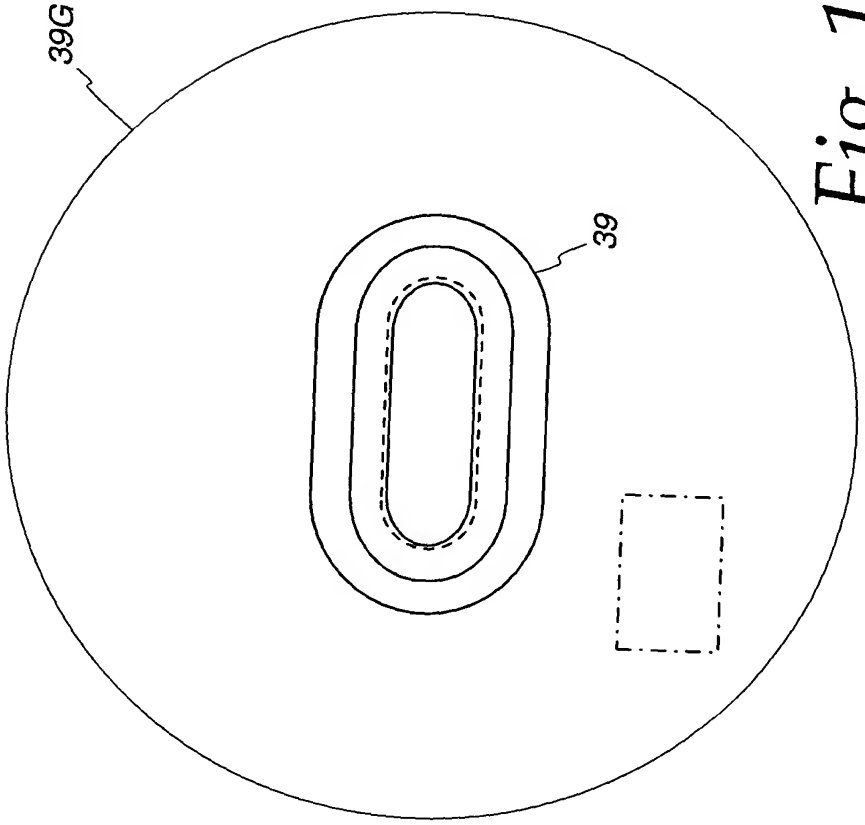


Fig. 10B

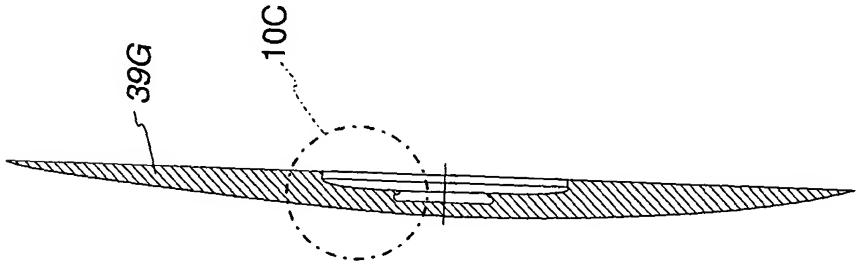


Fig. 11A

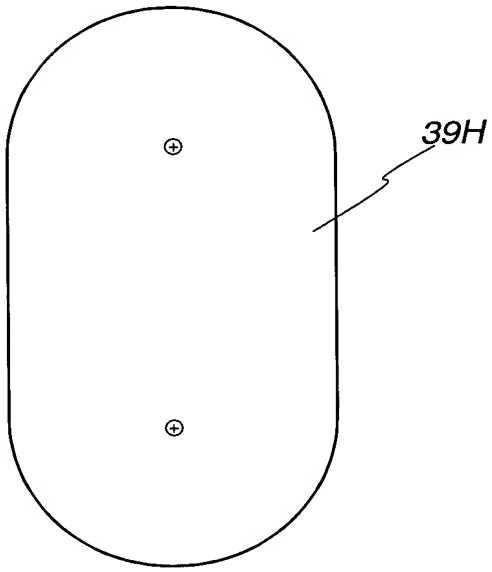
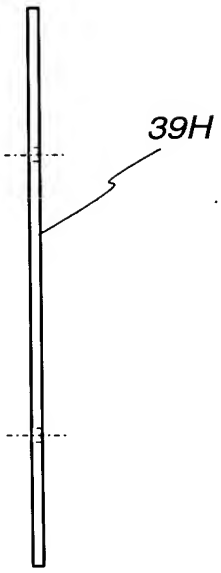


Fig. 11B



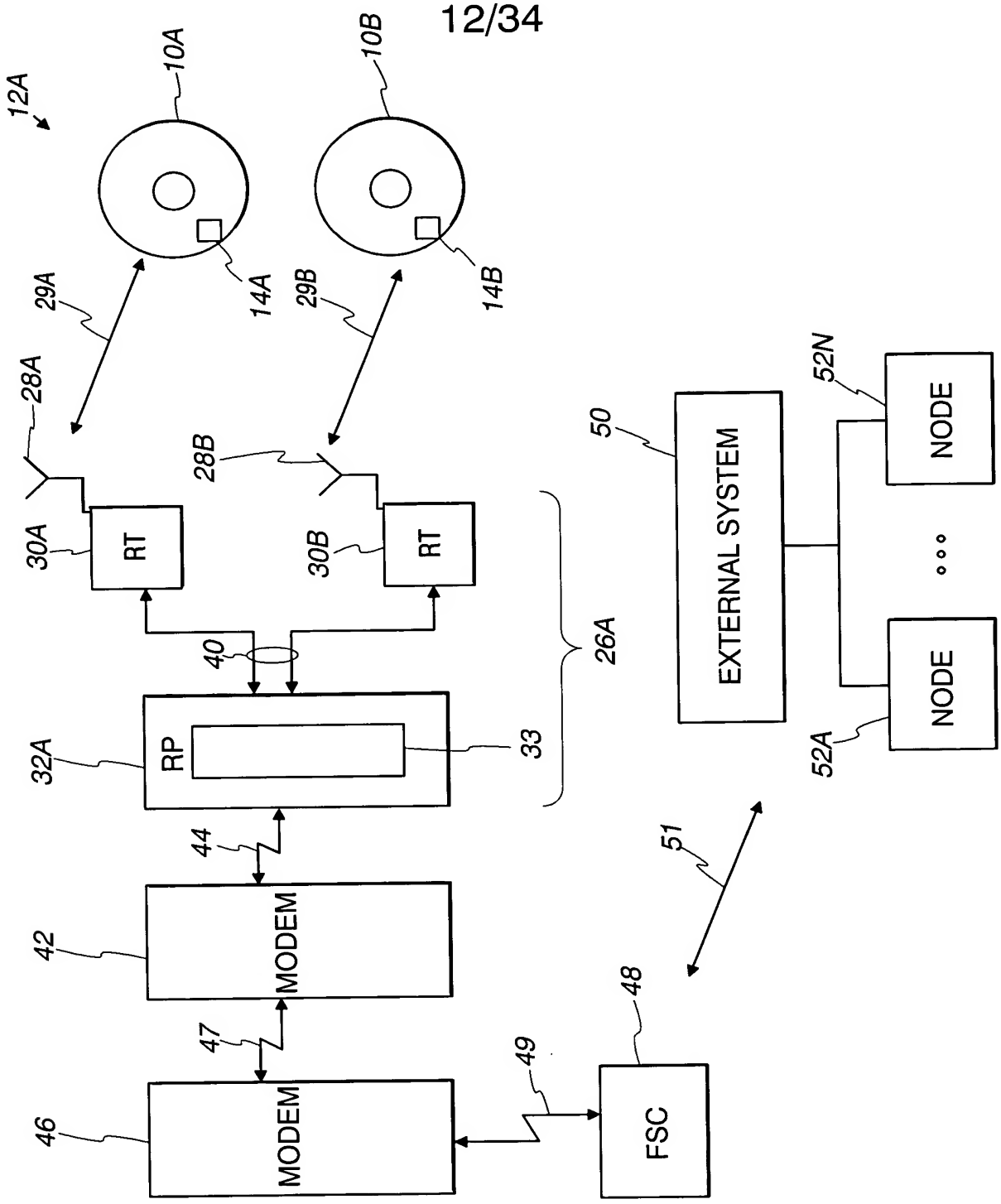

12A
10A
10B
14A
14B
29A
29B
28A
28B
30A
30B
RT
RT
40
RP
32A
33
26A
44
MODEM
42
47
MODEM
46
49
FSC
48
51
50
EXTERNAL SYSTEM
52N
NODE
NODE
52A

Fig. 12

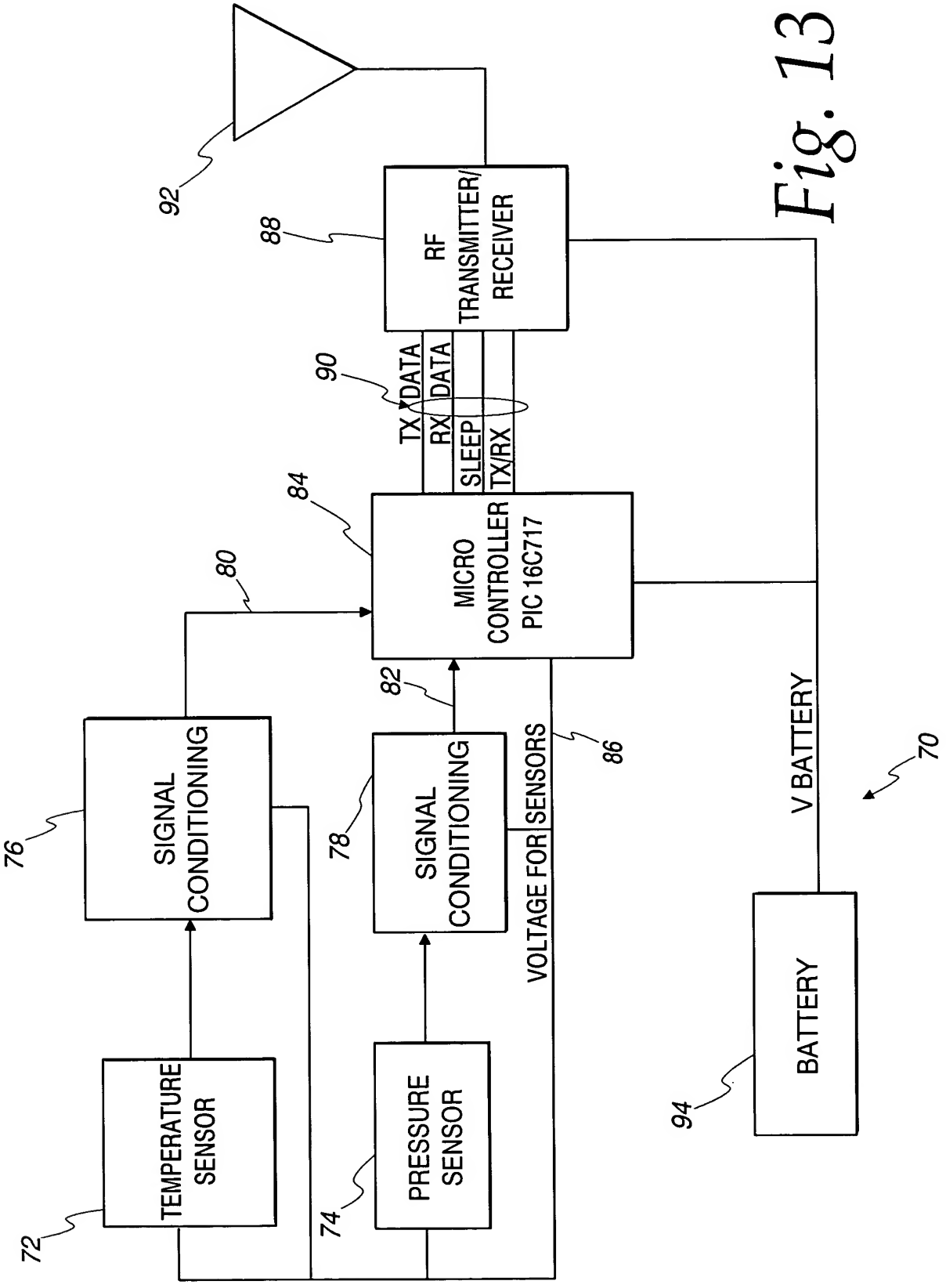

92
88
RF TRANSMITTER/ RECEIVER
90
TX DATA
RX DATA
SLEEP
TX/RX
84
MICRO CONTROLLER PIC 16C717
80
82
86
76
SIGNAL CONDITIONING
78
SIGNAL CONDITIONING
VOLTAGE FOR SENSORS
V BATTERY
70
72
TEMPERATURE SENSOR
74
PRESSURE SENSOR
94
BATTERY

Fig. 13

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Fig. 14

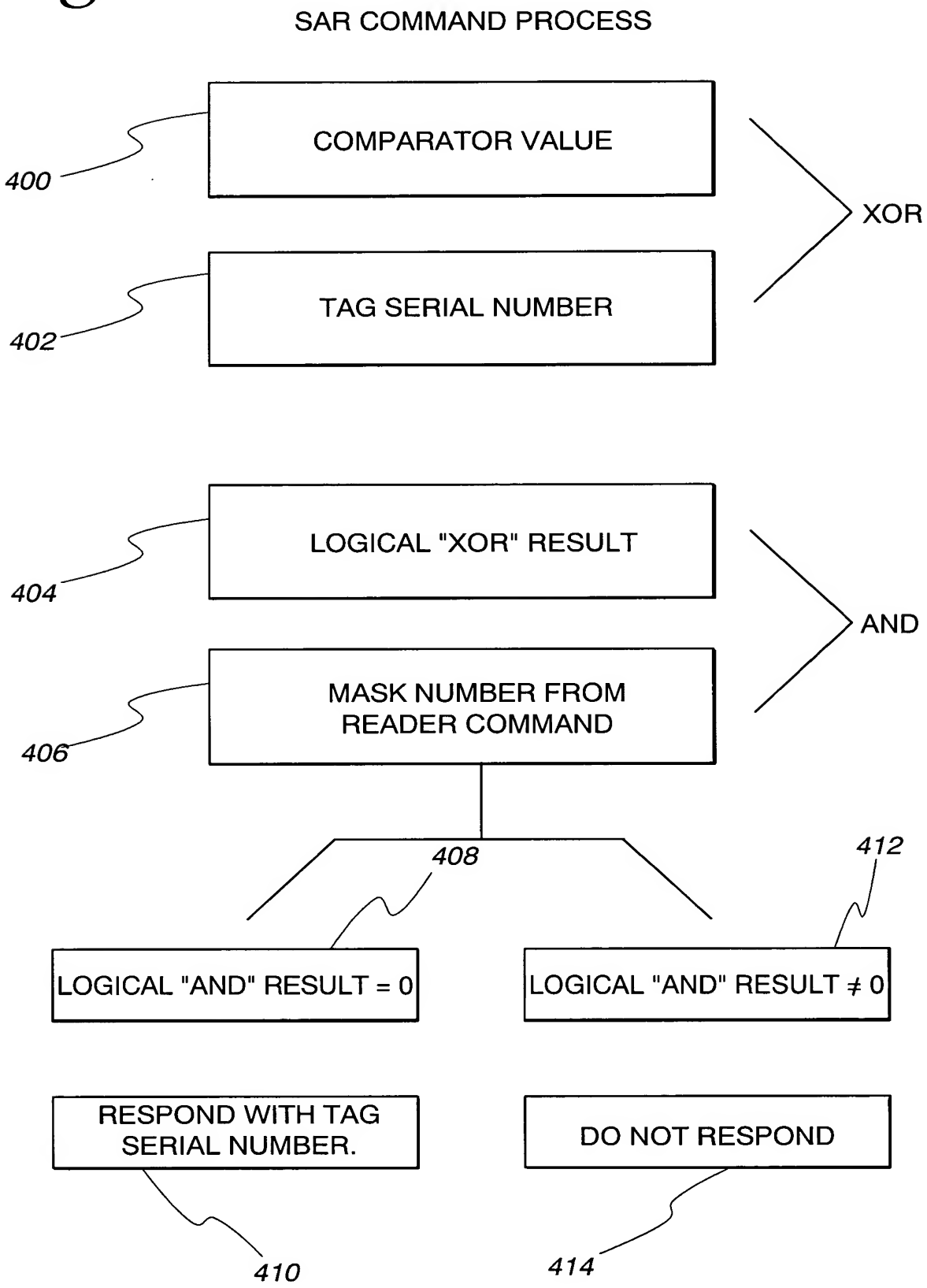


Fig. 15

READER
SAR ACQUISITION
FLOW DIAGRAM

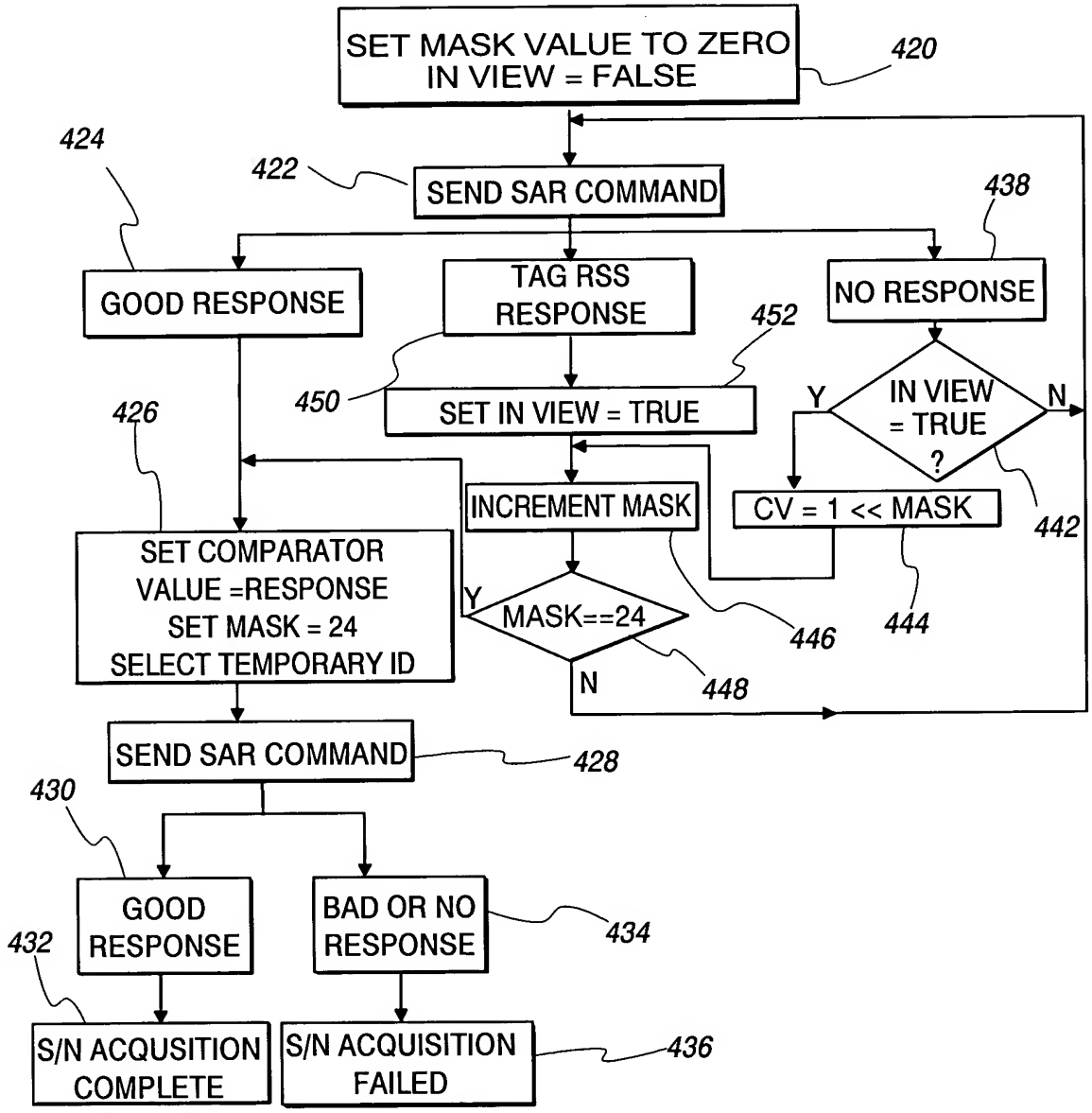
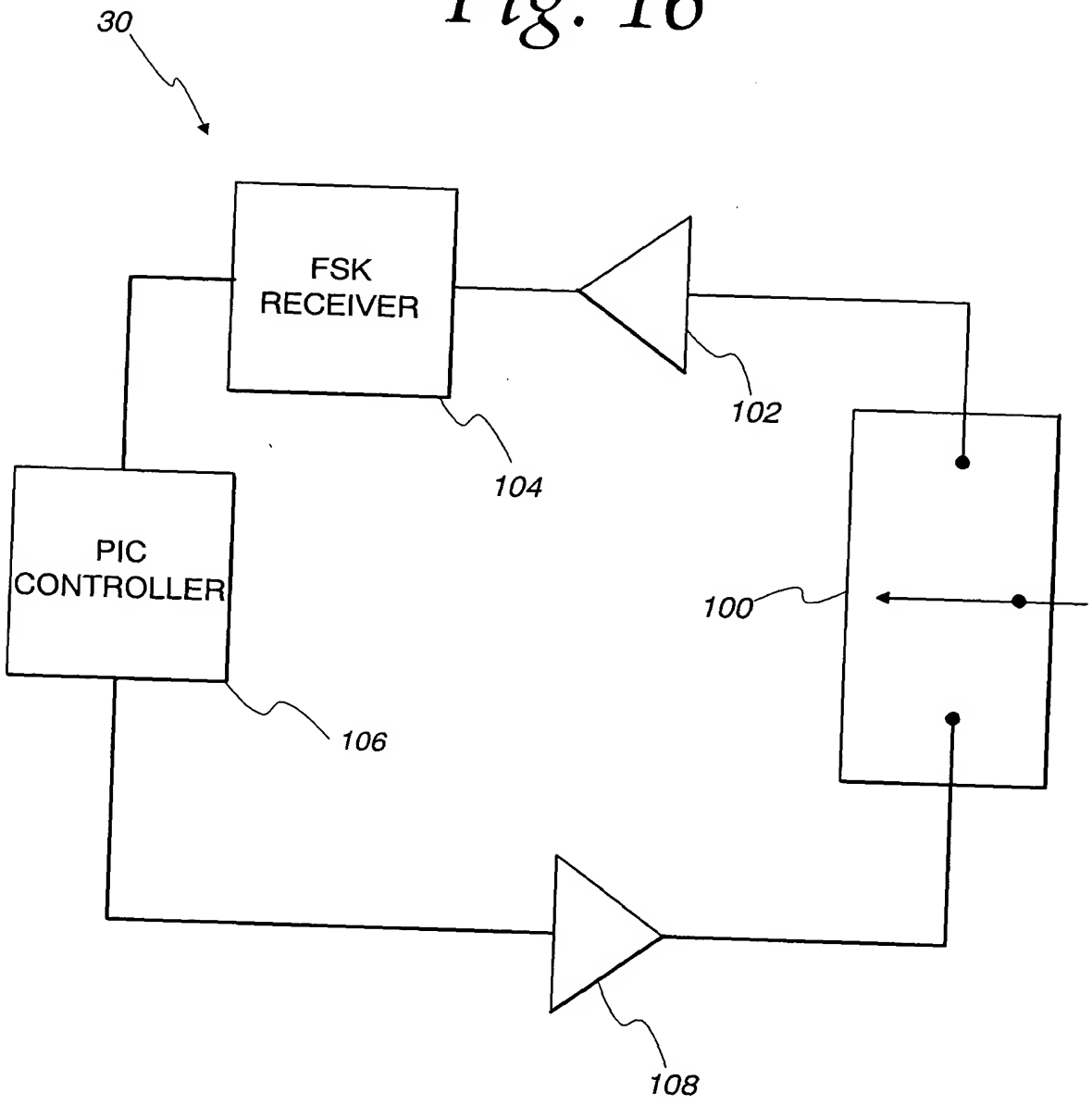


Fig. 16



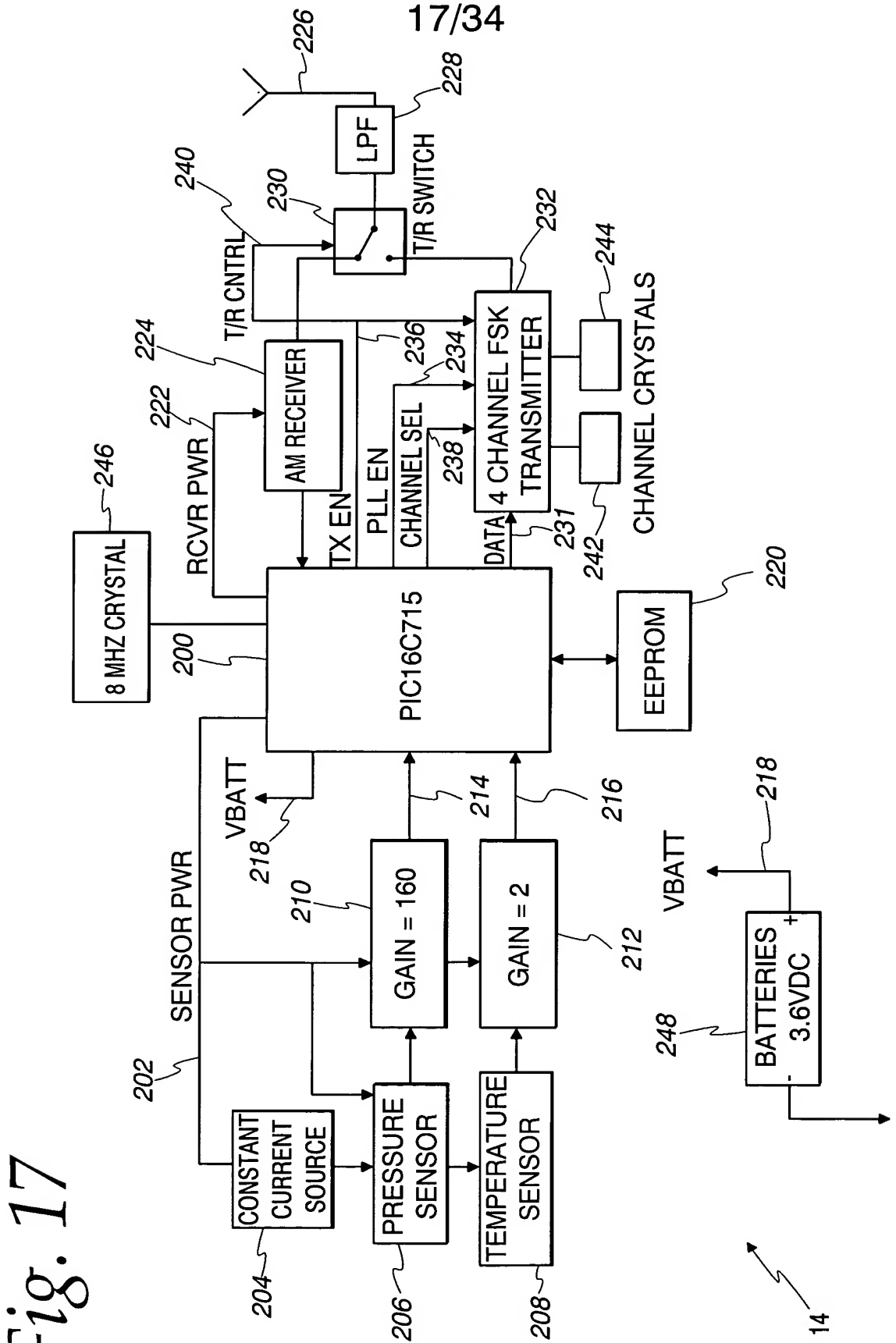

226
228
LPF
240
230
T/R SWITCH
T/R CNTRL
232
244
224
236
234
AM RECEIVER
4 CHANNEL FSK TRANSMITTER
CHANNEL CRYSTALS
222
RCVR PWR
PLL EN
CHANNEL SEL
238
246
TX EN
DATA
231
242
8 MHZ CRYSTAL
200
PIC16C715
EEPROM
220
VBATT
218
214
216
218
VBATT
SENSOR PWR
210
GAIN = 160
GAIN = 2
212
248
BATTERIES 3.6VDC
202
CONSTANT CURRENT SOURCE
PRESSURE SENSOR
TEMPERATURE SENSOR
204
206
208
14

Fig. 17

Fig. 18

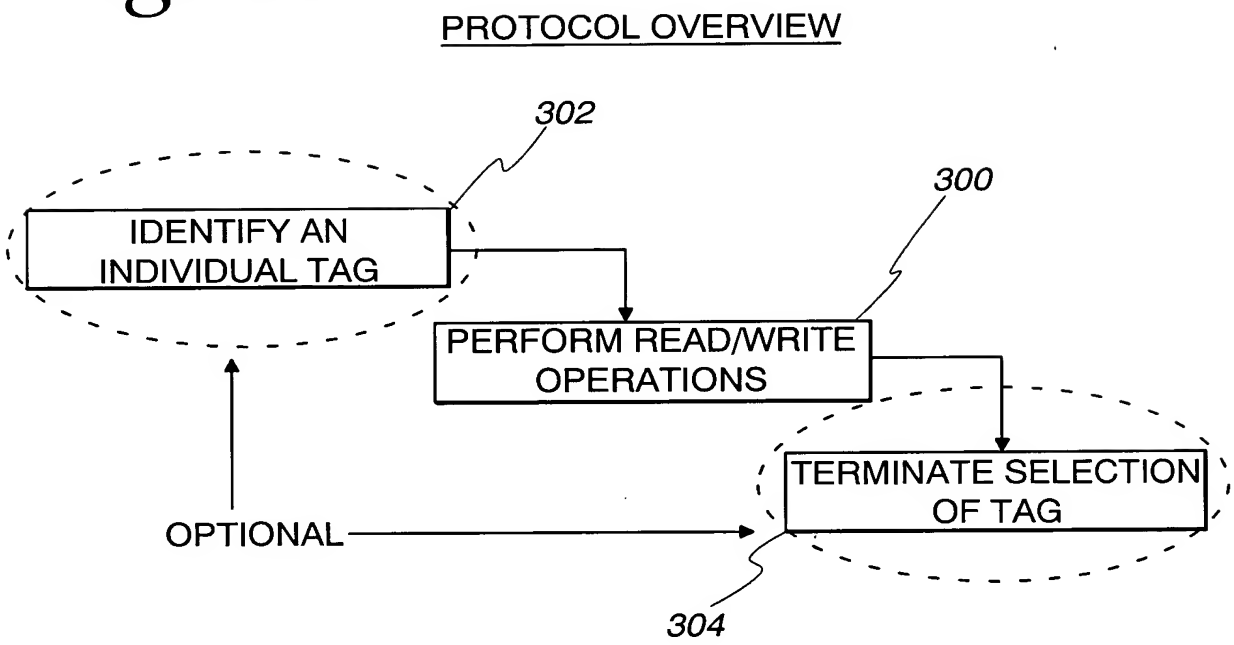
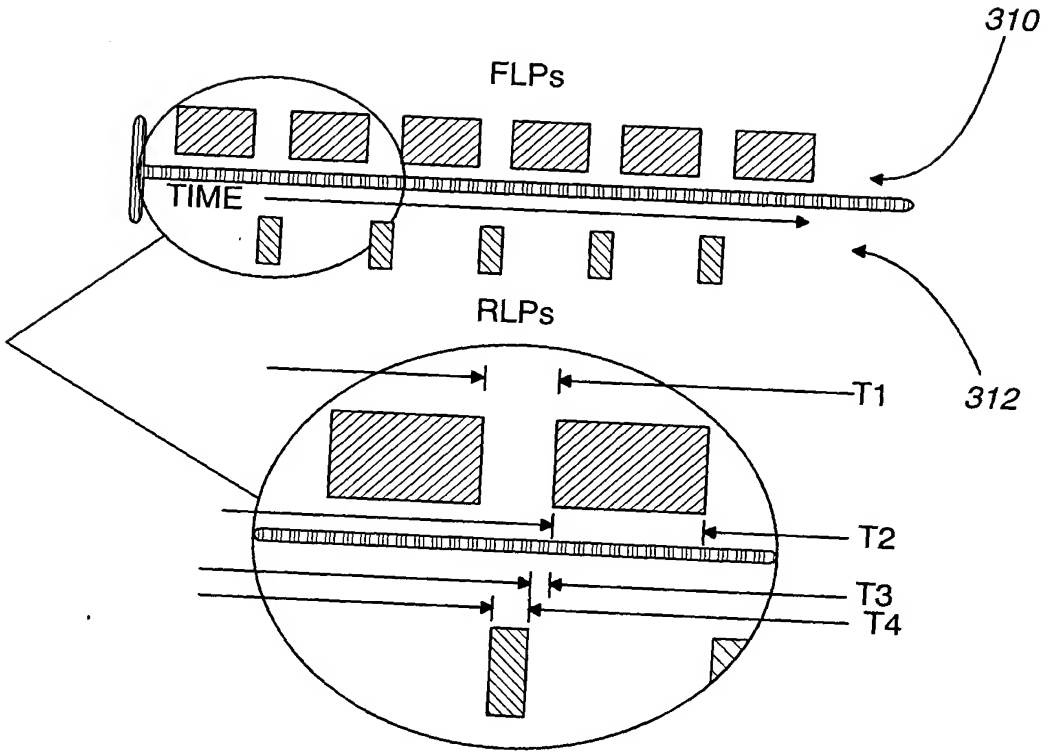

PROTOCOL OVERVIEW
302
300
IDENTIFY AN INDIVIDUAL TAG
PERFORM READ/WRITE OPERATIONS
TERMINATE SELECTION OF TAG
OPTIONAL
304

Fig. 19



PACKET TIMING

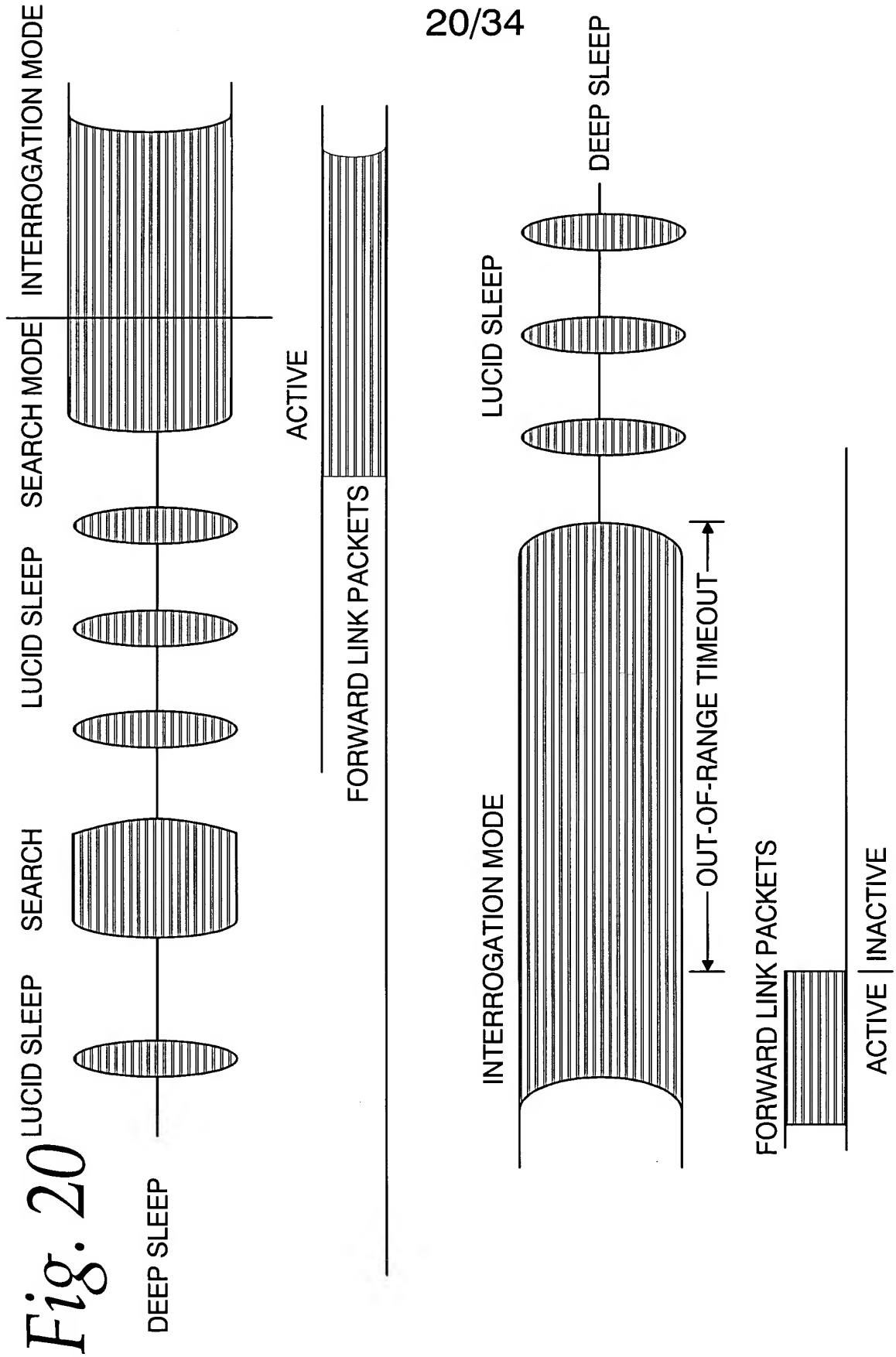

INTERROGATION MODE
SEARCH MODE
LUCID SLEEP
SEARCH
LUCID SLEEP
DEEP SLEEP
ACTIVE
FORWARD LINK PACKETS
DEEP SLEEP
LUCID SLEEP
INTERROGATION MODE
OUT-OF-RANGE TIMEOUT
FORWARD LINK PACKETS
ACTIVE
INACTIVE

Fig. 20

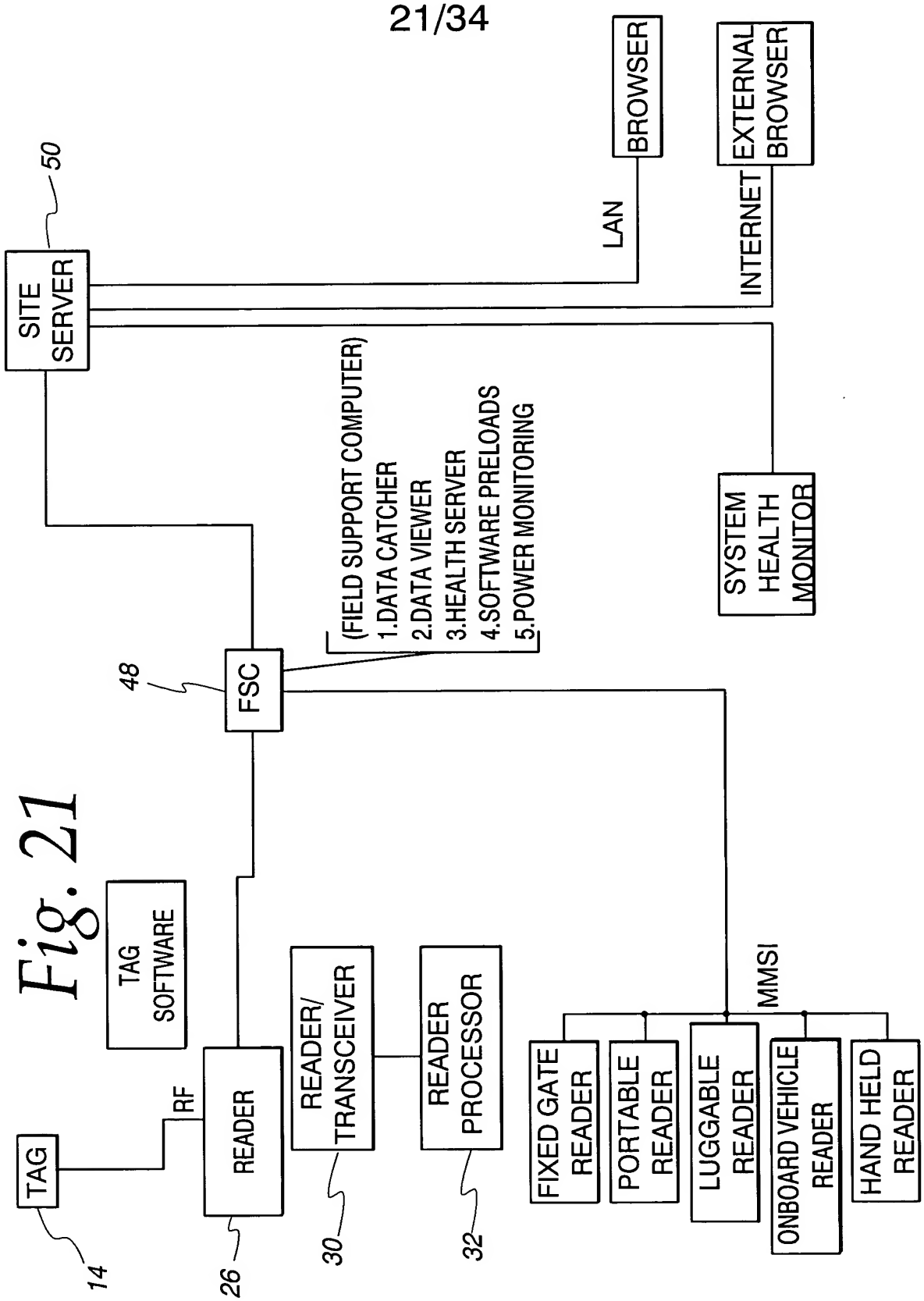

BROWSER
EXTERNAL BROWSER
LAN
INTERNET
50
SITE SERVER
(FIELD SUPPORT COMPUTER)
1.DATA CATCHER
2.DATA VIEWER
3.HEALTH SERVER
4.SOFTWARE PRELOADS
5.POWER MONITORING
SYSTEM HEALTH MONITOR
48
FSC
TAG SOFTWARE
MMSI
READER/ TRANSCEIVER
READER PROCESSOR
FIXED GATE READER
PORTABLE READER
LUGGABLE READER
ONBOARD VEHICLE READER
HAND HELD READER
RF
TAG
READER
14
26
30
32

Fig. 21

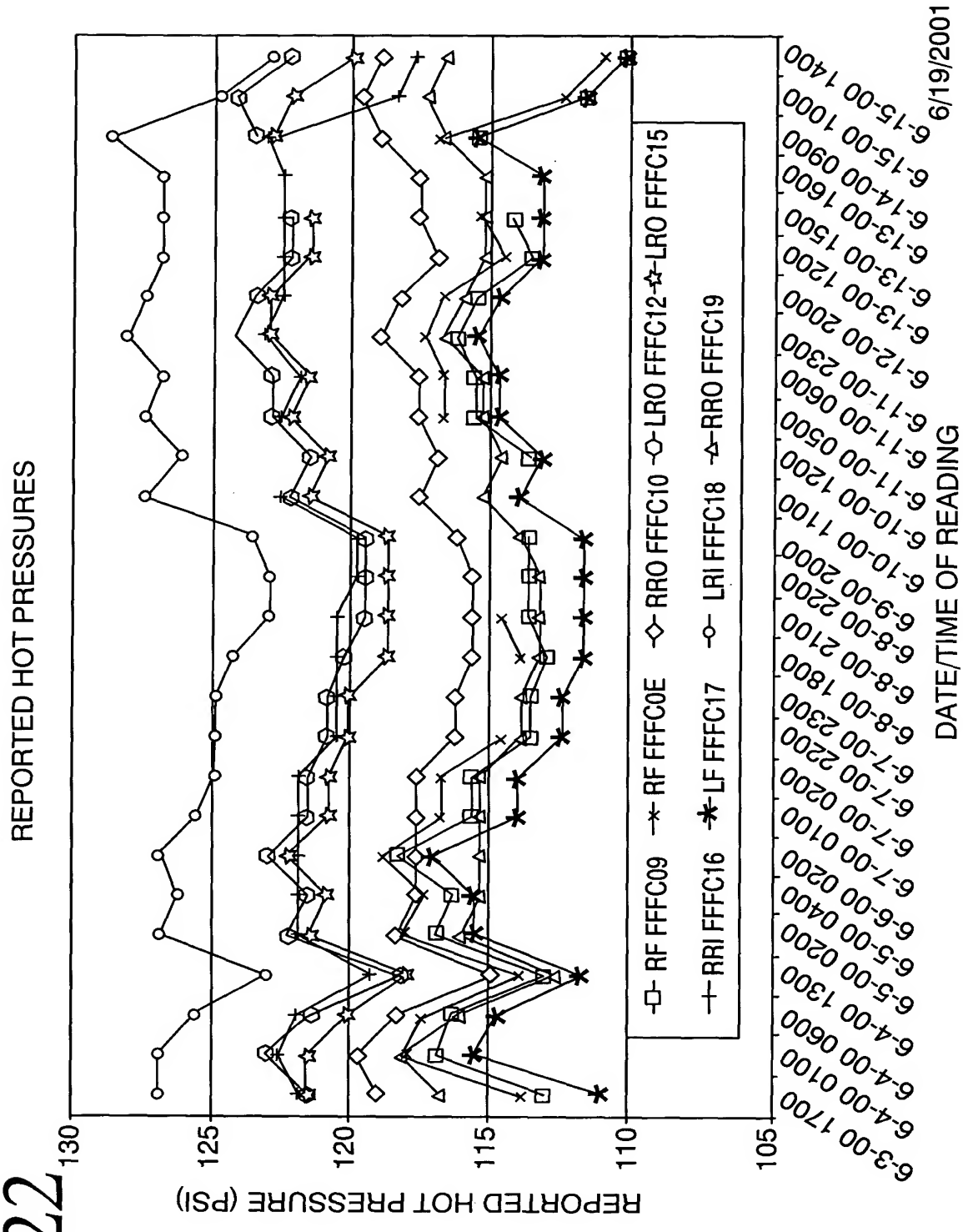

REPORTED HOT PRESSURES
REPORTED HOT PRESSURE (PSI)
130
125
120
115
110
105
RF FFFC09
RF FFFC0E
RRO FFFC10
LRO FFFC12
LRO FFFC15
RRI FFFC16
LF FFFC17
LRI FFFC18
RRO FFFC19
6-3-00 1700
6-4-00 0100
6-4-00 0600
6-4-00 1300
6-5-00 0200
6-5-00 0400
6-6-00 0200
6-7-00 0100
6-7-00 0200
6-7-00 2200
6-8-00 2300
6-8-00 1800
6-8-00 2100
6-9-00 2200
6-10-00 2000
6-10-00 1100
6-11-00 1200
6-11-00 0500
6-11-00 0600
6-12-00 2300
6-13-00 2000
6-13-00 1200
6-13-00 1500
6-14-00 1600
6-15-00 0900
6-15-00 1000
6-15-00 1400
6/19/2001
DATE/TIME OF READING

Fig. 22

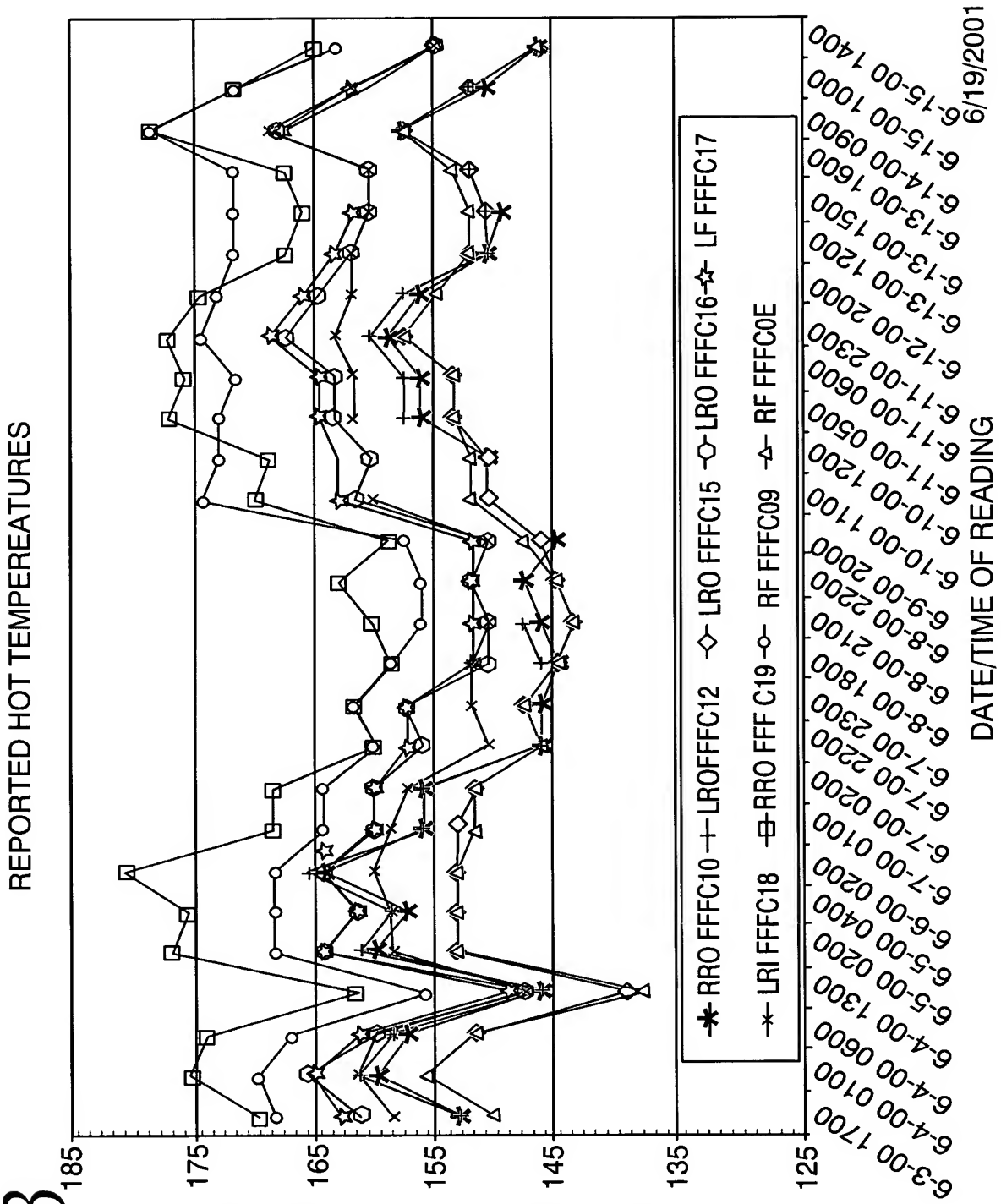

REPORTED HOT TEMPEREATURES
TAG TEMPERATURE (DEGREES F)
185
175
165
155
145
135
125
RRO FFFC10
LROFFFC12
LRO FFFC15
LRO FFFC16
LF FFFC17
LRI FFFC18
RRO FFF C19
RF FFFC09
RF FFFC0E
6-3-00 1700
6-4-00 0100
6-4-00 0600
6-4-00 1300
6-5-00 0200
6-5-00 1300
6-6-00 0400
6-7-00 0200
6-7-00 0100
6-7-00 0200
6-7-00 2200
6-7-00 2300
6-8-00 1800
6-8-00 2100
6-8-00 2200
6-9-00 2000
6-10-00 1100
6-10-00 1200
6-11-00 0500
6-11-00 0600
6-12-00 2300
6-13-00 2000
6-13-00 1200
6-13-00 1500
6-14-00 1600
6-15-00 0900
6-15-00 1000
6-15-00 1400
6/19/2001
DATE/TIME OF READING

Fig. 23

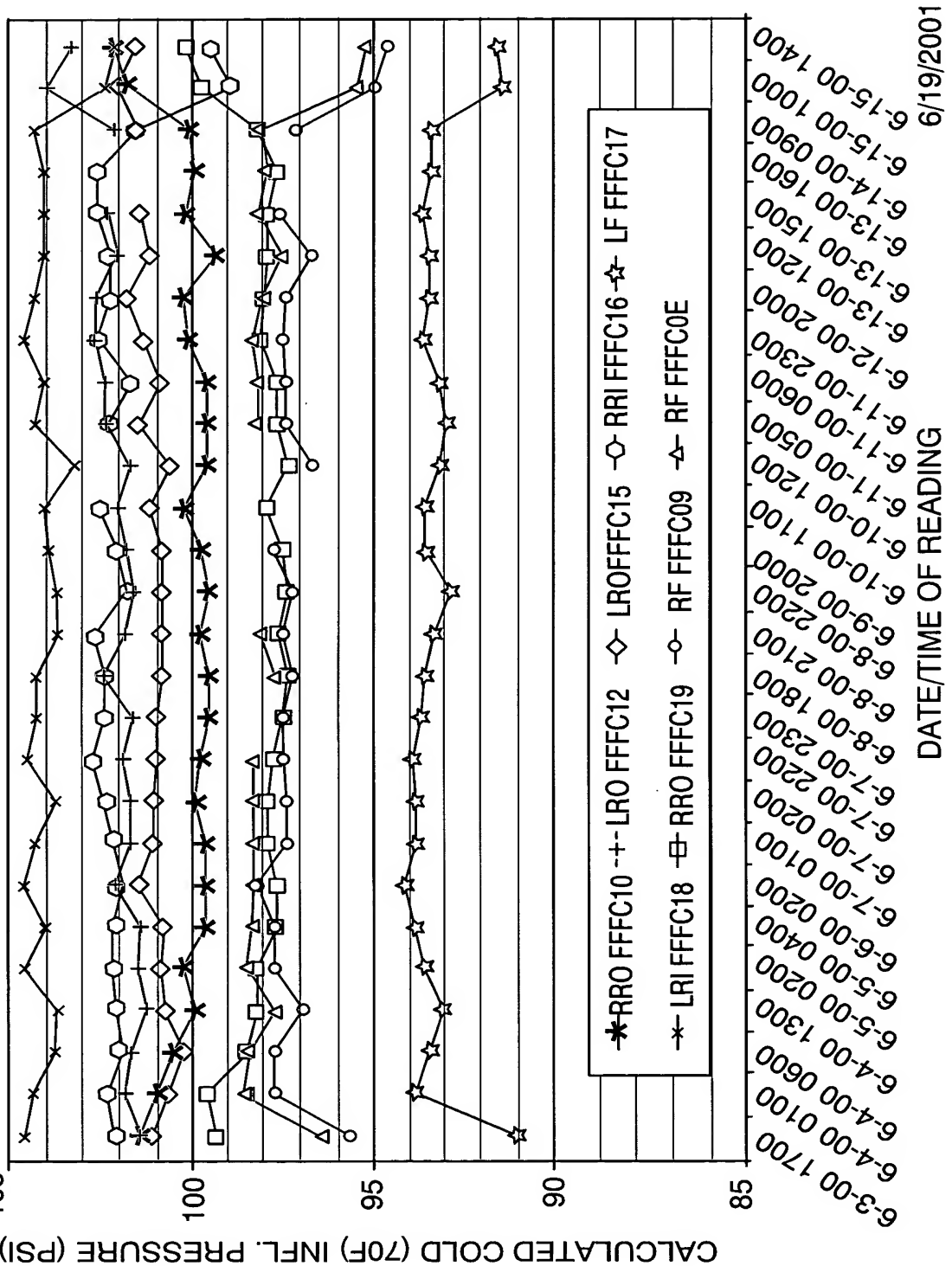

CALCULATED COLD INFLATION PRESSURES
CALCULATED COLD (70F) INFL. PRESSURE (PSI)
105
100
95
90
85
RRO FFFC10
LRO FFFC12
LROFFFC15
RRI FFFC16
LF FFFC17
LRI FFFC18
RRO FFFC19
RF FFFC09
RF FFFC0E
6-3-00 1700
6-4-00 0100
6-4-00 0600
6-4-00 1300
6-5-00 0200
6-5-00 1000
6-6-00 0400
6-7-00 0100
6-7-00 0200
6-7-00 2200
6-7-00 2300
6-8-00 1800
6-8-00 2100
6-8-00 2200
6-9-00 2000
6-10-00 1100
6-10-00 1200
6-11-00 0500
6-11-00 0600
6-11-00 2300
6-12-00 2000
6-13-00 1200
6-13-00 1500
6-13-00 1600
6-14-00 0900
6-15-00 1000
6-15-00 1400
6/19/2001
DATE/TIME OF READING

Fig. 24

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Ronald A. Sandler; 312-269-4352

Fig. 25

TAG FIRMWARE LAYERS

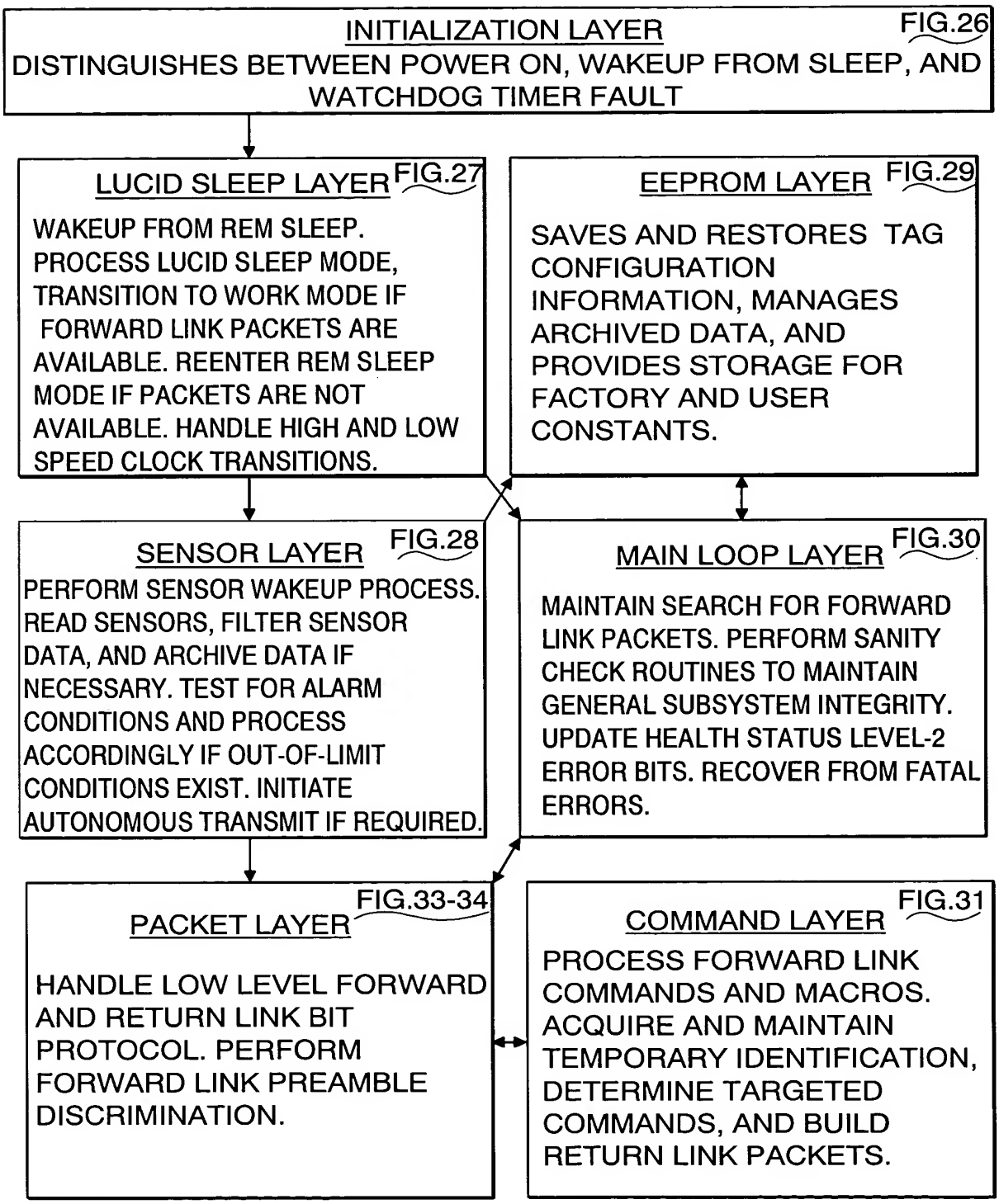

Fig. 26

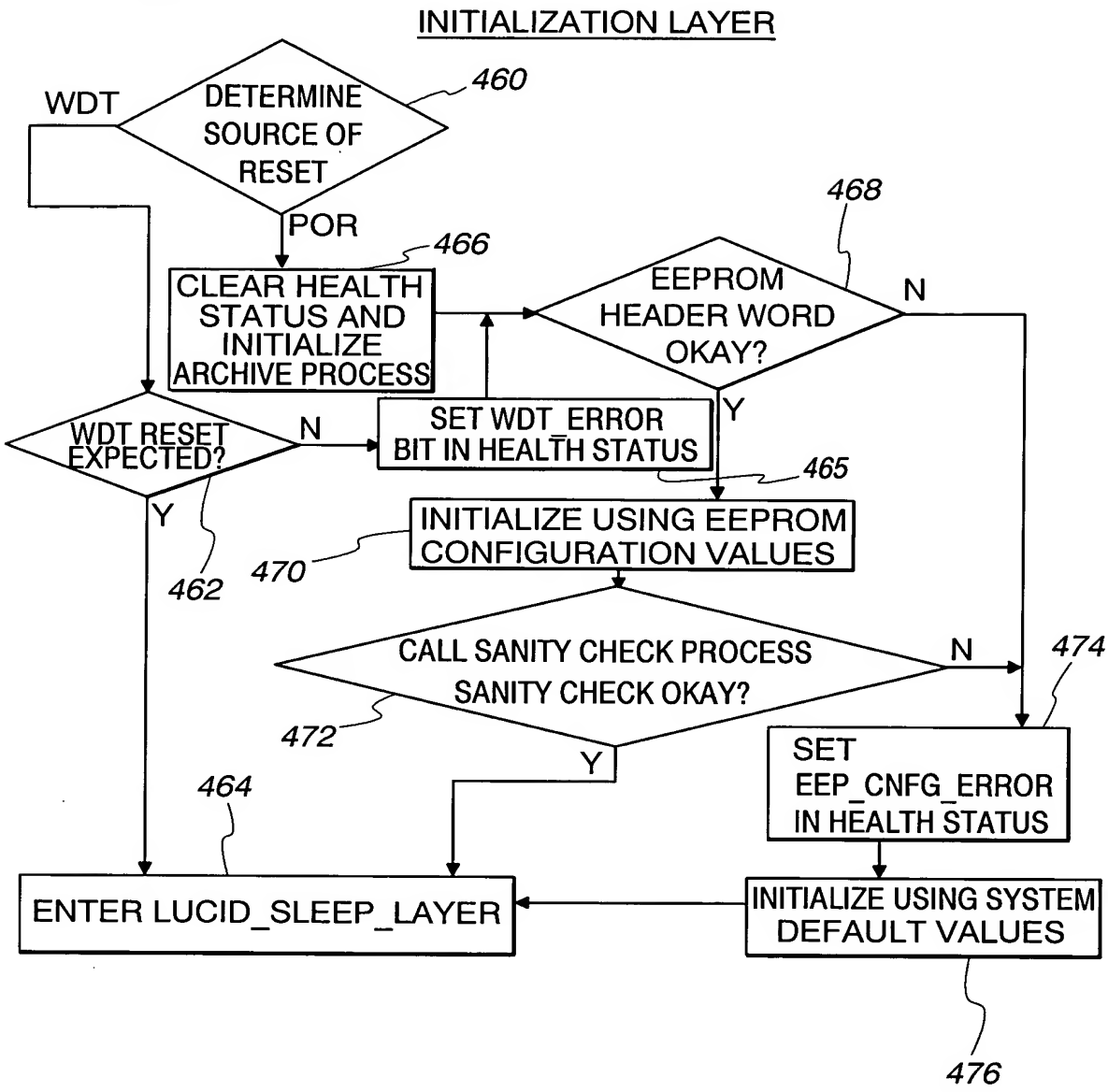
INITIALIZATION LAYER
WDT
DETERMINE SOURCE OF RESET
460
POR
466
CLEAR HEALTH STATUS AND INITIALIZE ARCHIVE PROCESS
468
EEPROM HEADER WORD OKAY?
N
Y
WDT RESET EXPECTED?
N
SET WDT_ERROR BIT IN HEALTH STATUS
465
Y
462
470
INITIALIZE USING EEPROM CONFIGURATION VALUES
CALL SANITY CHECK PROCESS SANITY CHECK OKAY?
N
474
472
Y
464
SET EEP_CNFG_ERROR IN HEALTH STATUS
ENTER LUCID_SLEEP_LAYER
INITIALIZE USING SYSTEM DEFAULT VALUES
476

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Fig. 27

LUCID SLEEP LAYER

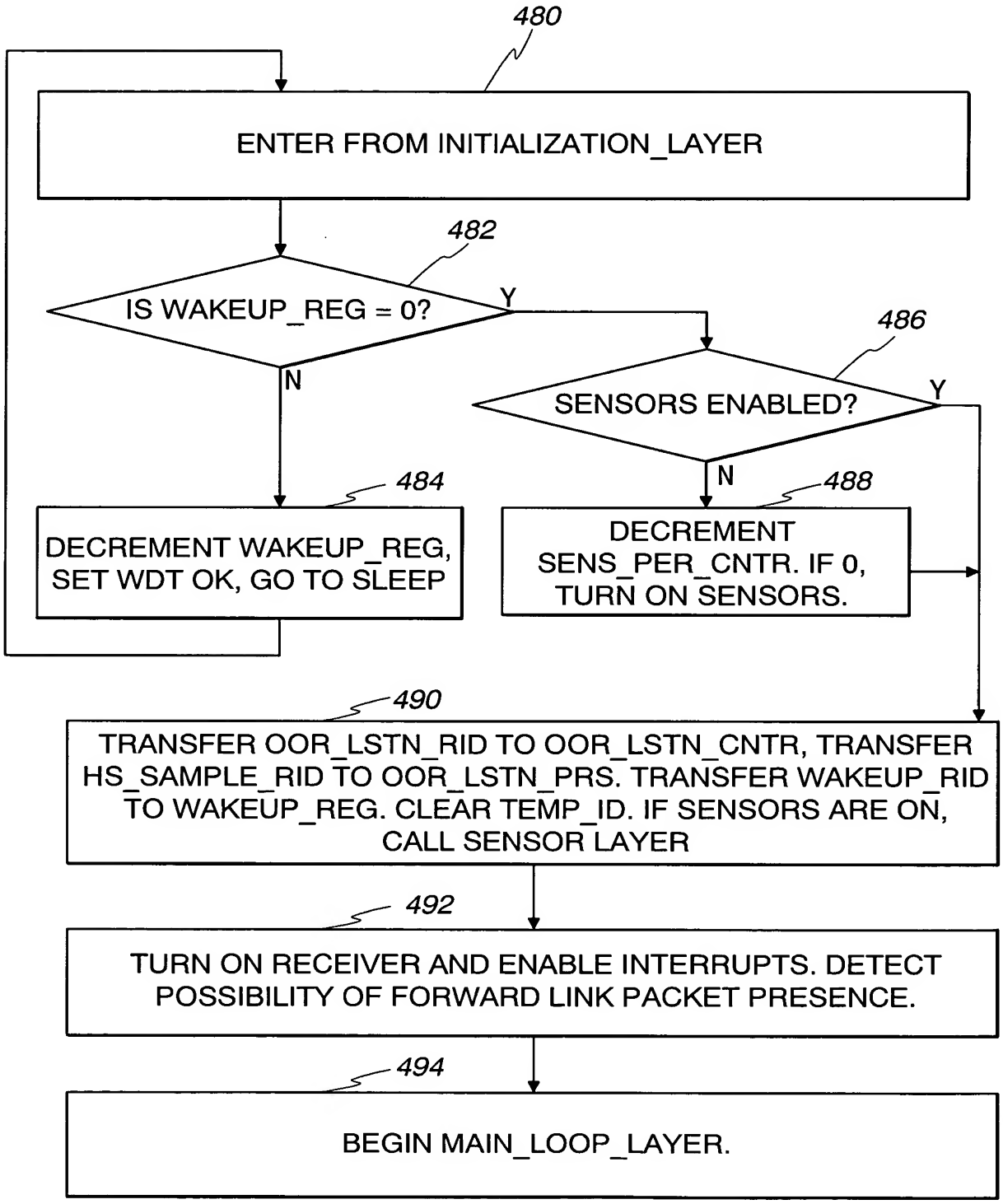

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Fig. 28

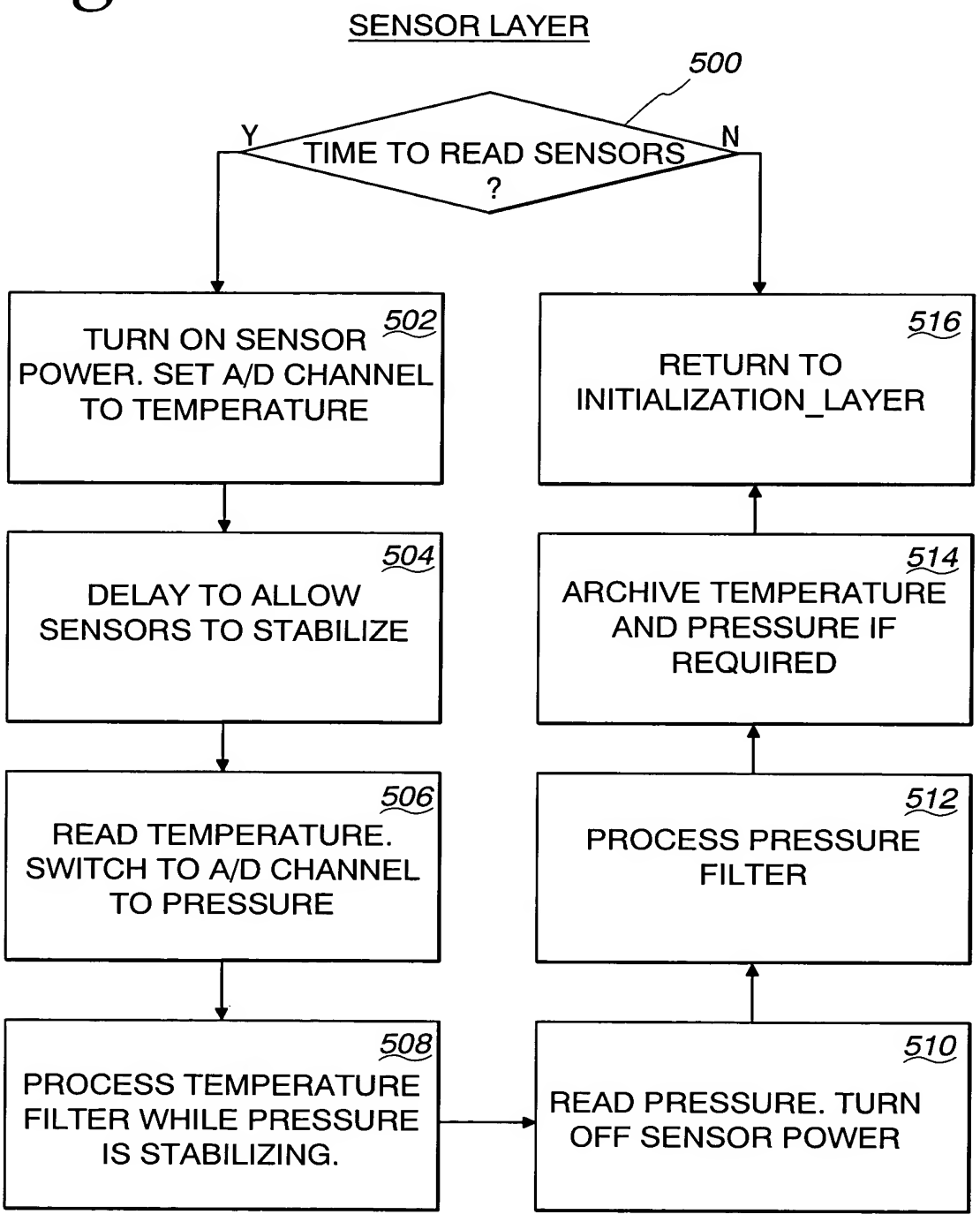

Fig. 29

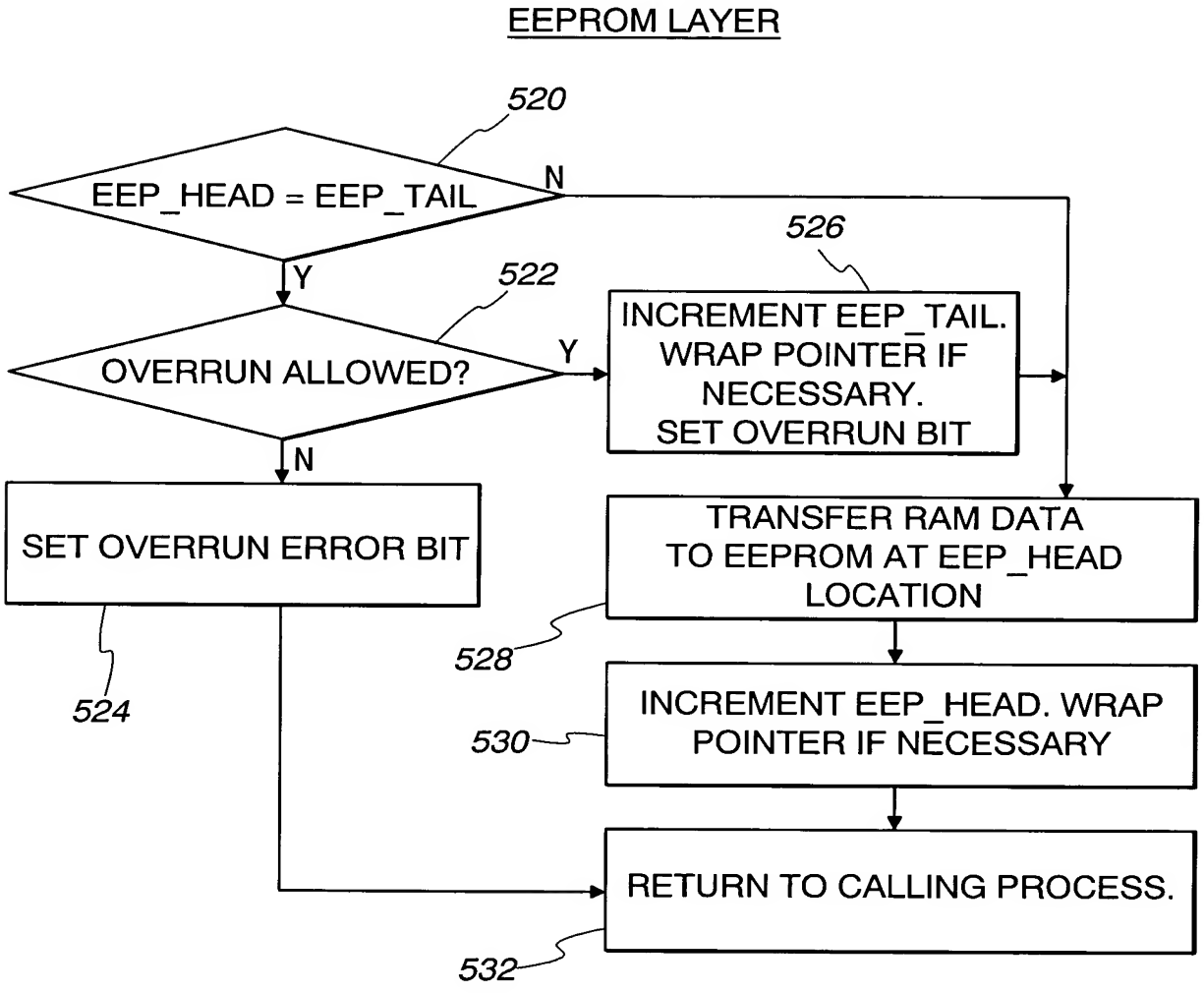
EEPROM LAYER
520
EEP_HEAD = EEP_TAIL
N
Y
522
OVERRUN ALLOWED?
Y
N
526
INCREMENT EEP_TAIL. WRAP POINTER IF NECESSARY. SET OVERRUN BIT
SET OVERRUN ERROR BIT
524
TRANSFER RAM DATA TO EEPROM AT EEP_HEAD LOCATION
528
INCREMENT EEP_HEAD. WRAP POINTER IF NECESSARY
530
RETURN TO CALLING PROCESS.
532

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Fig. 30

MAIN LOOP LAYER

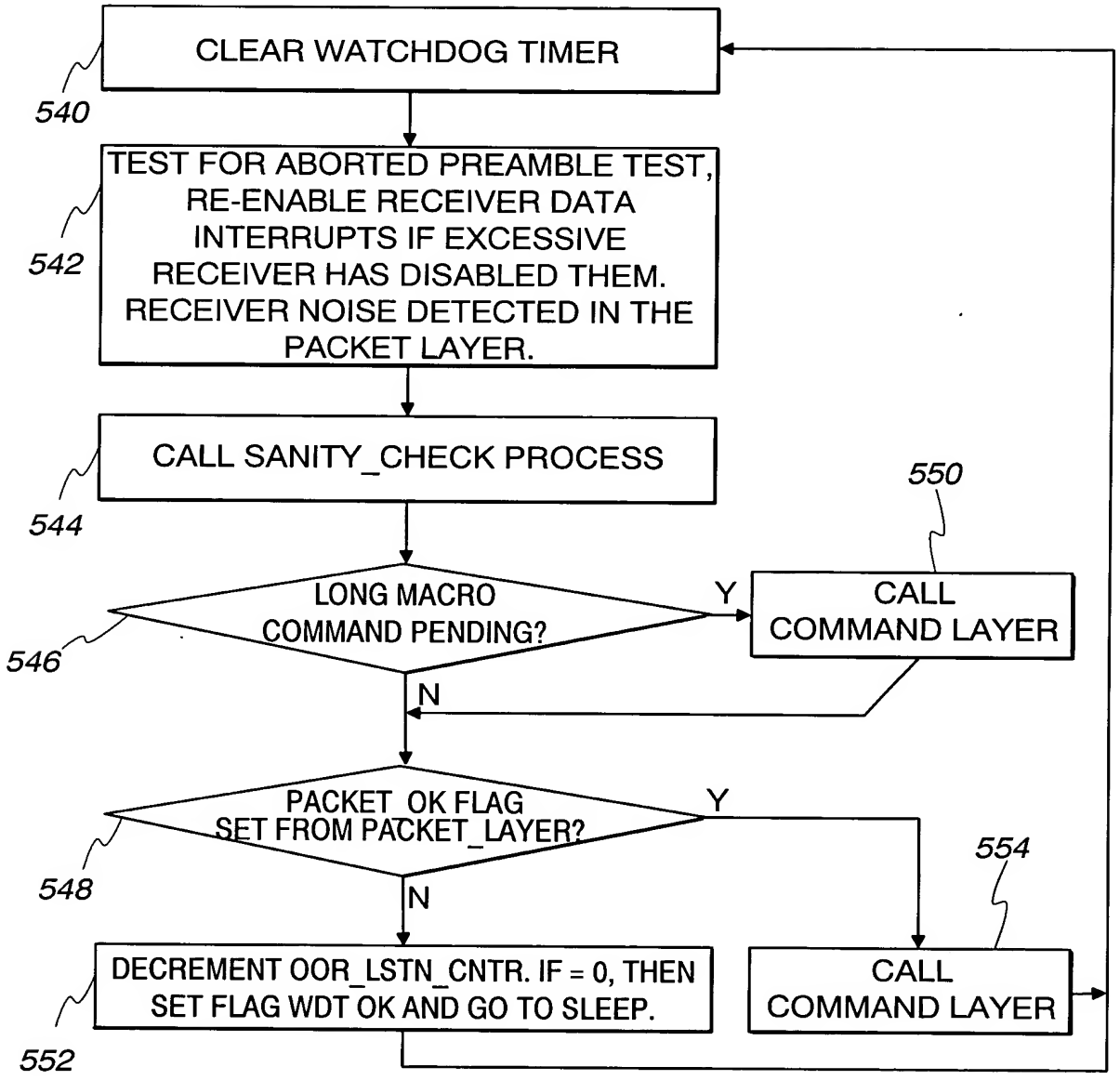

Fig. 31

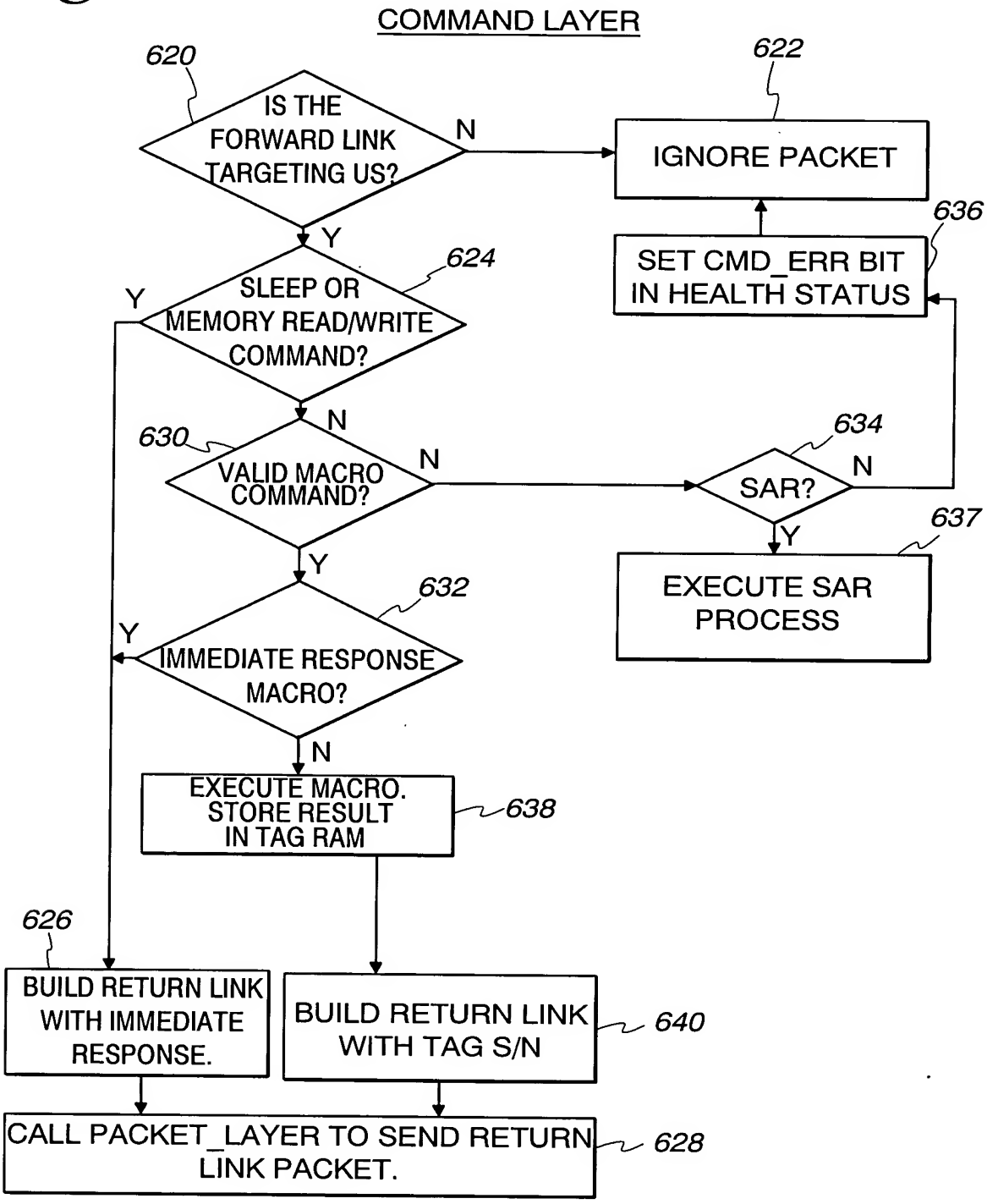
COMMAND LAYER
620
IS THE FORWARD LINK TARGETING US?
N
622
IGNORE PACKET
Y
636
SET CMD_ERR BIT IN HEALTH STATUS
624
SLEEP OR MEMORY READ/WRITE COMMAND?
Y
N
630
VALID MACRO COMMAND?
N
634
SAR?
N
Y
637
EXECUTE SAR PROCESS
Y
632
IMMEDIATE RESPONSE MACRO?
Y
N
EXECUTE MACRO. STORE RESULT IN TAG RAM
638
626
BUILD RETURN LINK WITH IMMEDIATE RESPONSE.
BUILD RETURN LINK WITH TAG S/N
640
CALL PACKET_LAYER TO SEND RETURN LINK PACKET.
628

Fig. 32

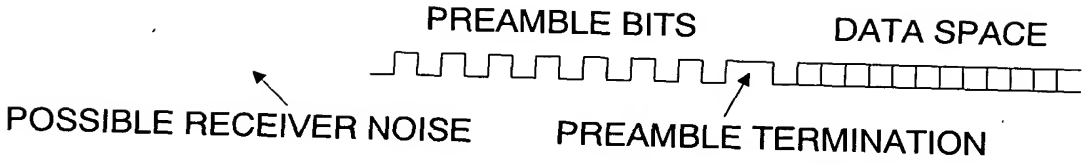
PREAMBLE BITS
DATA SPACE
POSSIBLE RECEIVER NOISE
PREAMBLE TERMINATION

Fig. 33

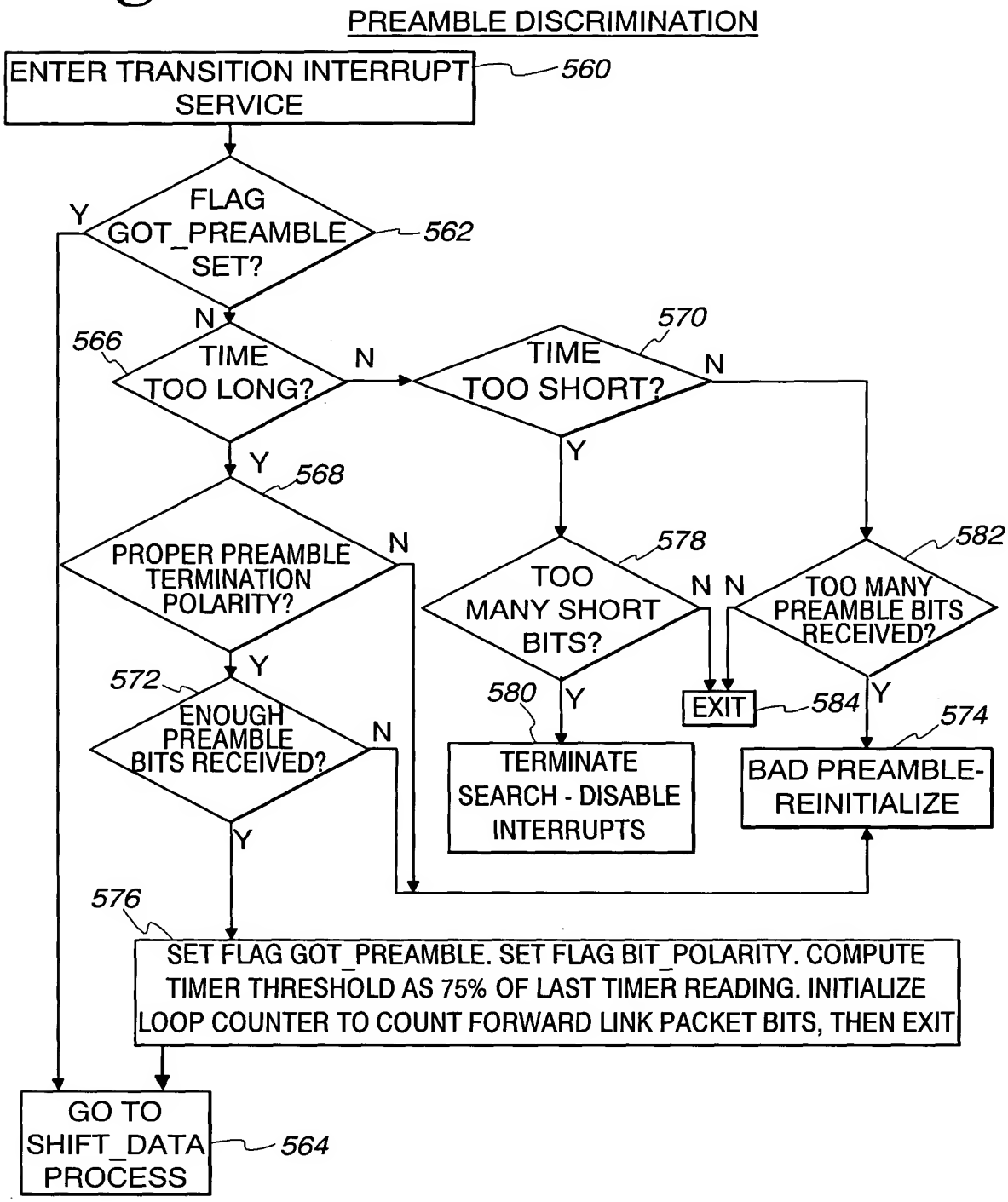
PREAMBLE DISCRIMINATION
ENTER TRANSITION INTERRUPT SERVICE
560
FLAG GOT_PREAMBLE SET?
562
Y
N
566
TIME TOO LONG?
N
570
TIME TOO SHORT?
N
Y
Y
568
PROPER PREAMBLE TERMINATION POLARITY?
N
578
TOO MANY SHORT BITS?
N N
582
TOO MANY PREAMBLE BITS RECEIVED?
Y
572
ENOUGH PREAMBLE BITS RECEIVED?
N
580
Y
EXIT
584
Y
574
TERMINATE SEARCH - DISABLE INTERRUPTS
BAD PREAMBLE-REINITIALIZE
Y
576
SET FLAG GOT_PREAMBLE. SET FLAG BIT_POLARITY. COMPUTE TIMER THRESHOLD AS 75% OF LAST TIMER READING. INITIALIZE LOOP COUNTER TO COUNT FORWARD LINK PACKET BITS, THEN EXIT
GO TO SHIFT_DATA PROCESS
564

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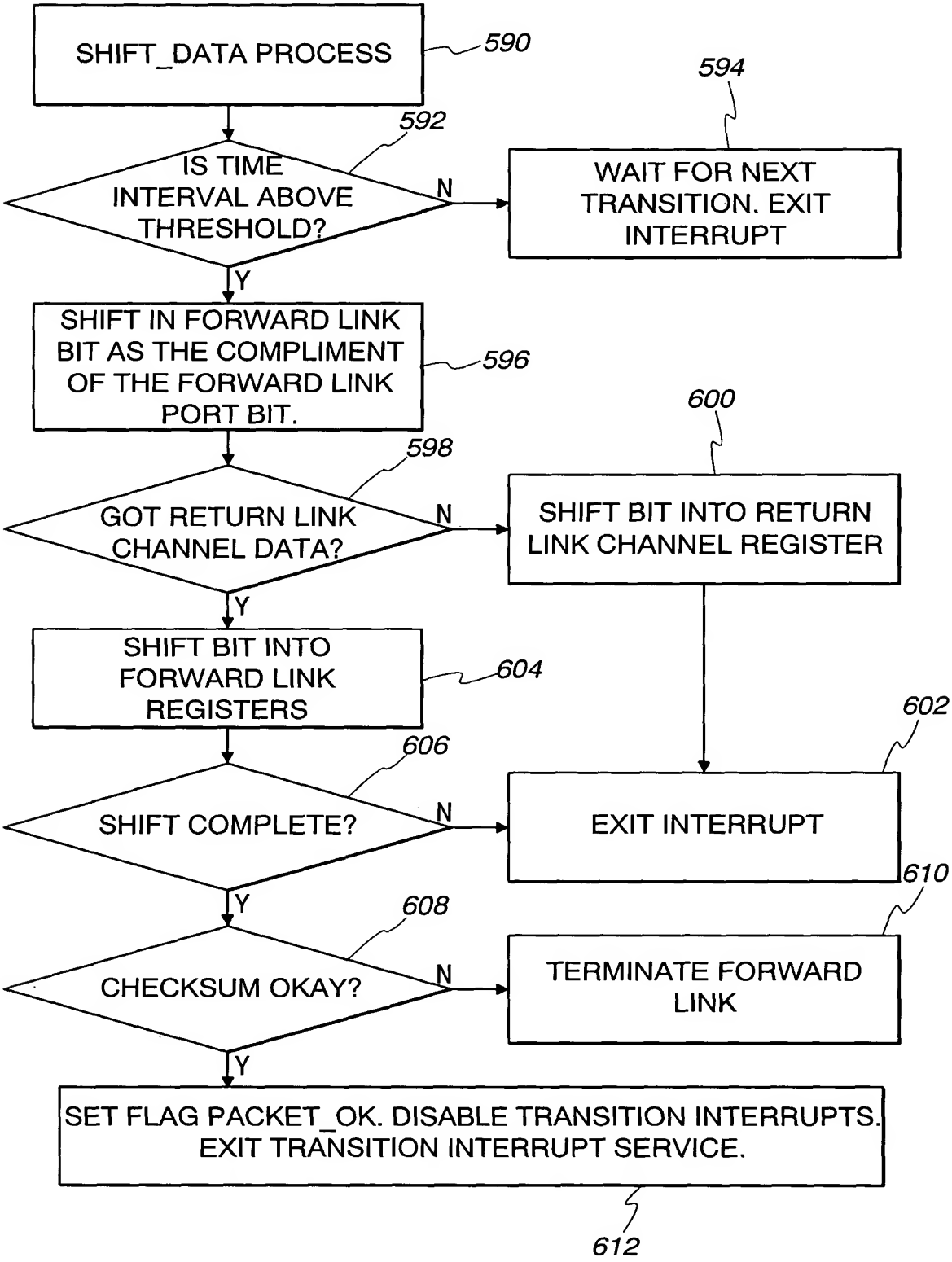
Fig. 34

SHIFT DATA PROCESS